SOIL SURVEY OF

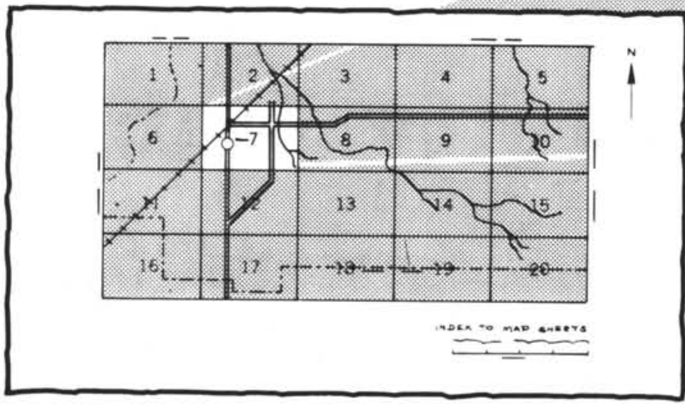
Lancaster County, Nebraska

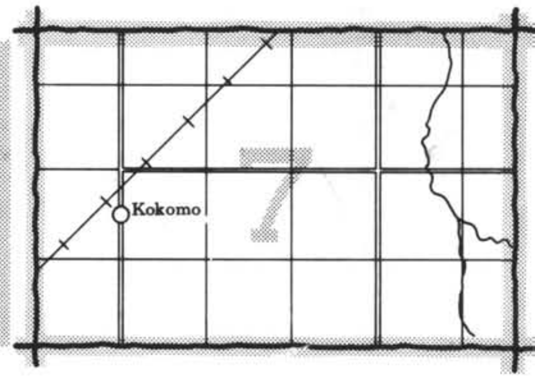
NOTICE – Potential Update
Soils information in this manuscrip
is current as of the publication dat
Situations like erosion, floods, or
updated mapping may have
changed some content slightly on
few acres. The most current soils
information is available on-line at
the Nebraska NRCS web site hon
page, in the e-FOTG (electronic
Field Office Technical Guide). Th
website is www.ne.nrcs.usda.gov, the
click on e-FOTG. This data is als
available at the NRCS Field Office
serving this county.

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Nebraska, Conservation and Survey Division

HOW TO US

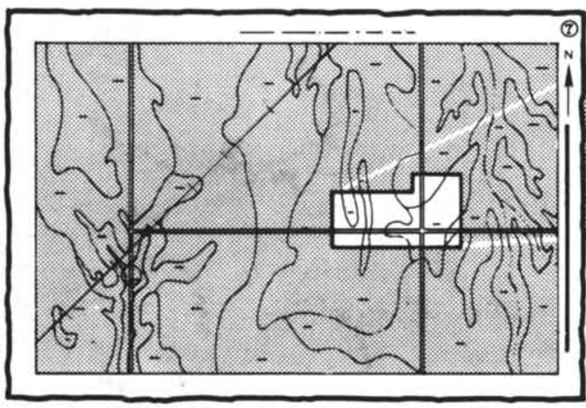
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

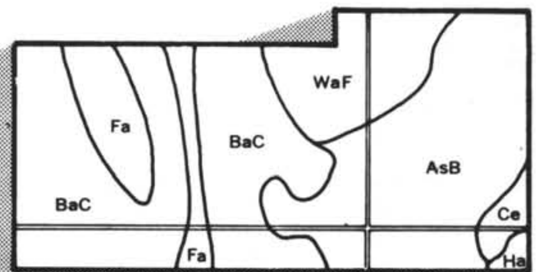




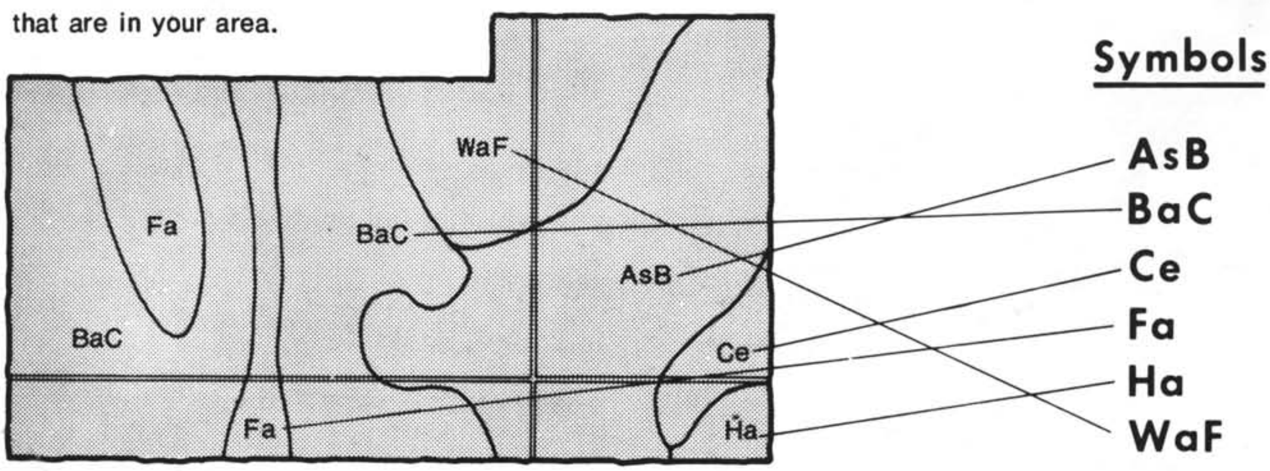
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



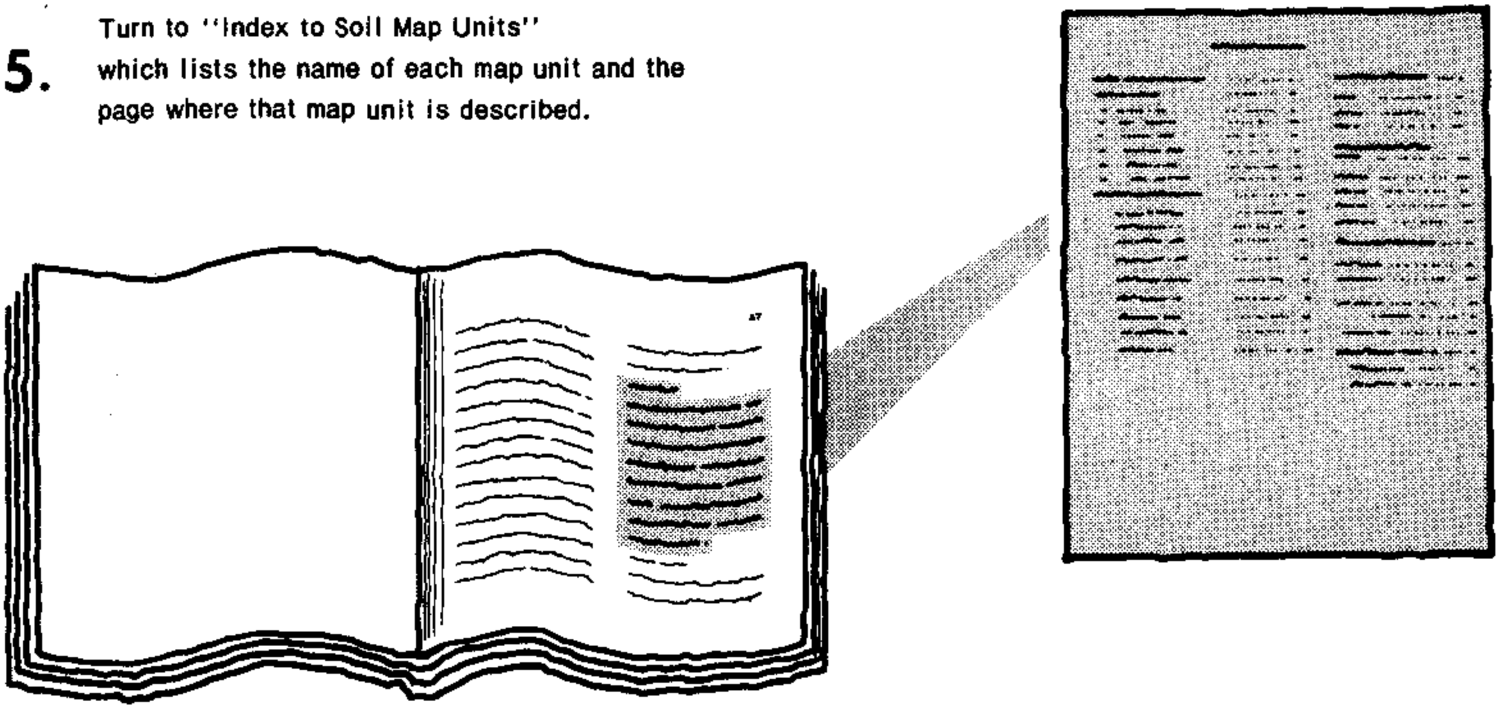


4. List the map unit symbols that are in your area.

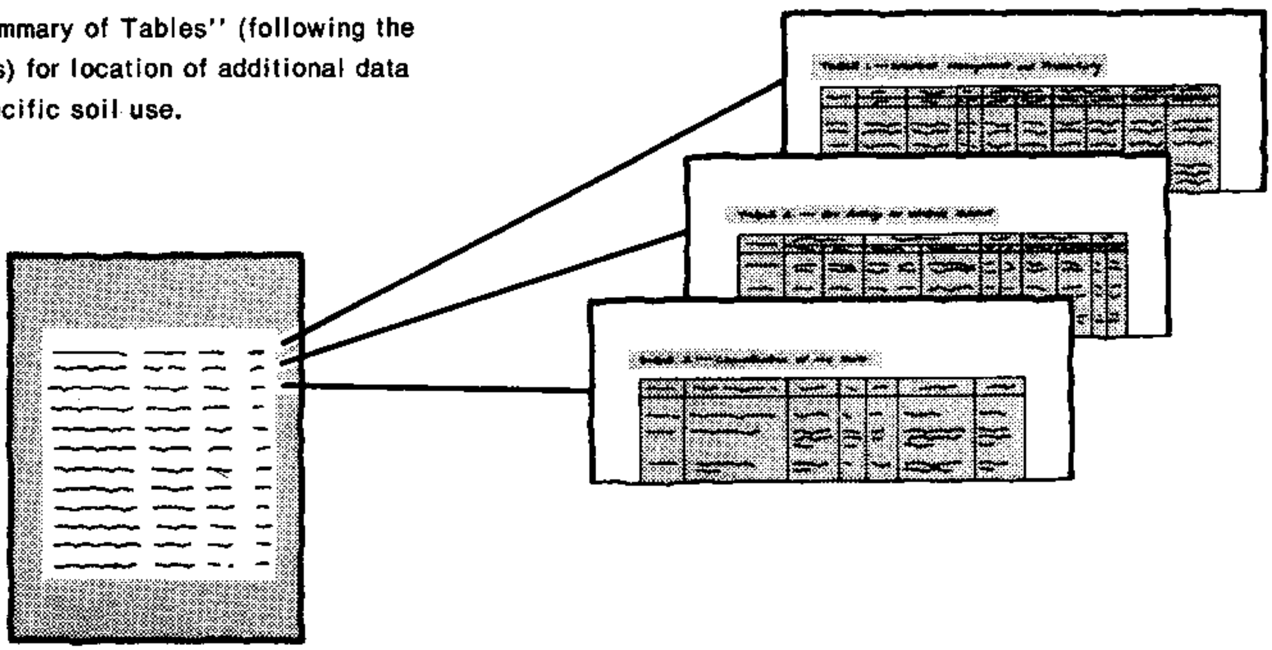


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, University of Nebraska, Conservation and Survey Division, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1965-77. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Platte South and the Nemaha Natural Resource Districts. The Lower Platte South Natural Resource District and Old West Commission provided financial assistance to accelerate soil survey field mapping.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Contour farming, terraces, grassed waterways, and farmstead windbreaks in the Wymore-Pawnee association.

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Issued May 1980

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Foreword

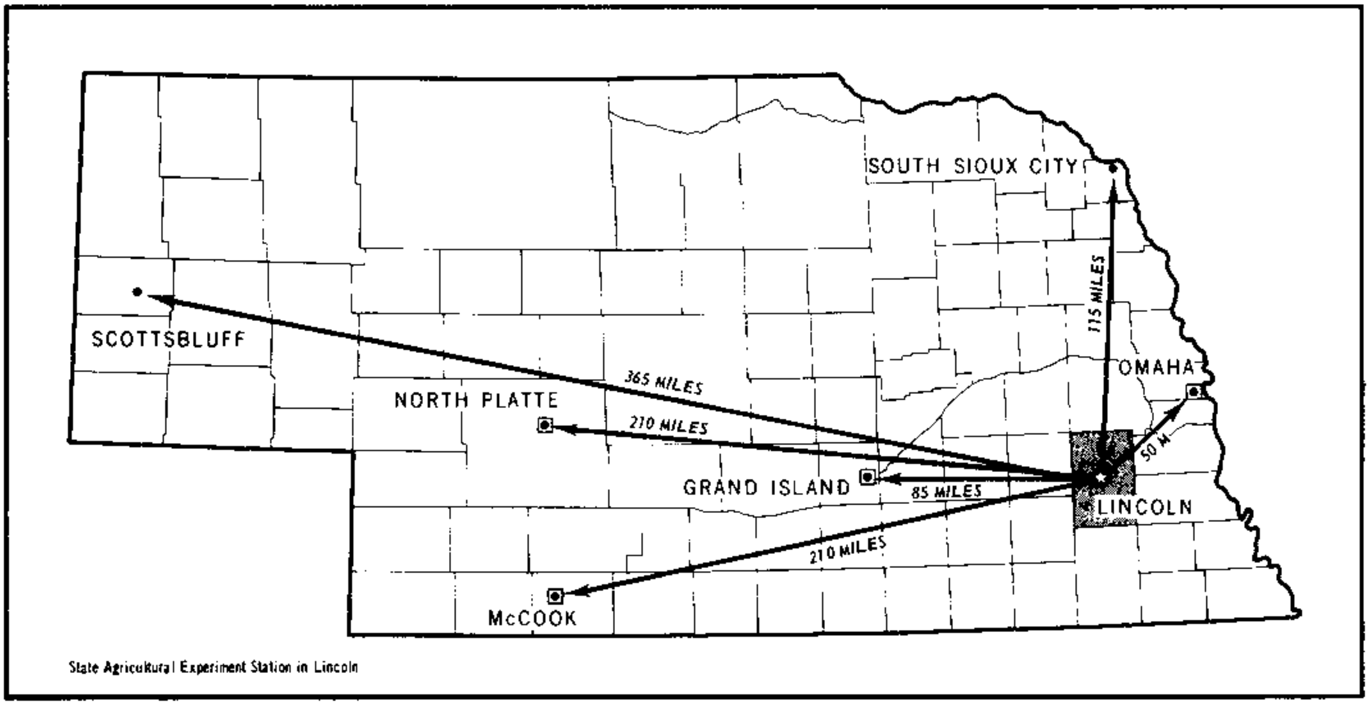
This soil survey contains information that can be used in land-planning programs in Lancaster County, Nebraska. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Benny Martin
State Conservationist
Soil Conservation Service



Location of Lancaster County in Nebraska.

SOIL SURVEY OF LANCASTER COUNTY, NEBRASKA

By Lawrence E. Brown, Loyal Quandt, Steve Scheinost, Jay Wilson, and Doug Witte, Soil Scientists, Soil Conservation Service, and Steve Hartung, Research Soil Scientist, Conservation and Survey Division, University of Nebraska

United States Department of Agriculture, Soil Conservation Service, in cooperation with University of Nebraska, Conservation and Survey Division

LANCASTER COUNTY is in southeast Nebraska. It is rectangular in shape, extending 36 miles from north to south and 24 miles from east to west. The county covers 545,856 acres, of which 4,800 acres is areas of water larger than 40 acres. In 1970, Lancaster County had a population of 167,972, and Lincoln, the county seat and State capital, had a population of 149,518. Lincoln presently covers an area of about 50 square miles.

A survey of Lancaster County was published in 1948 (*3*). The present survey updates the earlier survey and provides additional information and larger maps that show the soils in greater detail.

General nature of the survey area

This section provides general information about Lancaster County. It describes history and development; physiography, relief, and drainage; natural vegetation; transportation; manufacturing; farming; school facilities; geology; ground water; and climate.

History and development

Dense stands of tall, sod forming grasses and scattered woodlands along streams covered these soils before settlers came into the area. Most of the Indians who lived here subsisted on wild game, fish, and native fruits, but a few Indians grew small quantities of corn and vegetables.

The first settlement in the county was made along Salt Creek in 1856 by John D. Prey. A settlement called Lancaster was made near present day Salt Lake in 1857 by W. T. Donavan. This settlement was abandoned, but the name Lancaster was given to a village later established on a part of the present site of Lincoln.

Men were attracted to Salt Creek Valley by the saline deposits. An early attempt was made to evaporate the saline waters in Salt Creek to obtain salt. The salt was sold to settlers, hunters, and Indians. A wagonload of flour was commonly exchanged for a wagonload of salt, pound for pound. The salt, however, was less abundant and more difficult to purify than was expected, and production ceased after railroad connections were established.

Settlement was slow until 1859 when the overland trail to the west was changed to a more direct route that crossed this territory. In 1859, Lancaster County was formed, and in 1863, it was enlarged to its present size by the addition of an area to the south from a part of what was then called Clay County. In 1864, the village of Lancaster was made county seat, and in 1867, it was renamed Lincoln and was made the State capital.

Physiography, relief, and drainage

Lancaster County is near the eastern edge of the Great Plains area. In general, the county is moderately well drained or well drained. The aspect is mostly northward and eastward to the Platte River through Salt Creek and its tributaries. The extreme southern and southeastern parts are drained by tributaries of the Big Blue and Nemaha Rivers.

The highest elevation is about 1,520 feet in the extreme northwestern part of the county about 5 miles northwest of Agnew and in the extreme southwestern part of the county about 4 miles south of Kramer. The lowest elevation is 1,080 feet in the northeastern part where Salt Creek leaves the county.

The relief is dominantly gently sloping to strongly sloping throughout the county. In the area along the divide between Hallam and Panama a few places are nearly level.

The county has three main physiographic areas: uplands, stream terraces, and bottom lands. The uplands, which comprise roughly 80 percent of the county, consist of areas of glacial till covered with loess. The uplands are generally moderately well drained or well drained.

The stream terraces are mainly along Salt Creek and its larger tributaries. The larger and higher terraces are

chiefly in the vicinity of Lincoln and Waverly. Most stream terraces are moderately well drained or somewhat poorly drained.

The bottom lands border the major drainageways. The lowest areas have old channels or oxbows that flood frequently. The slightly higher areas are only occasionally flooded or rarely flooded and are more extensive than the frequently flooded areas. A few areas are wet because of poor surface drainage.

Natural vegetation

The native vegetation of Lancaster County is mid and tall grasses. These prairie grasses grew luxuriantly before the area was broken by the plow. The grasses on the uplands consisted primarily of big bluestem, little bluestem, needlegrass, side-oats grama, junegrass, and prairie dropseed. The grasses on the bottom lands consisted of big bluestem, indiangrass, and wildrye in the better drained areas; sloughgrass, sedges, and cattails in the poorly drained areas; and saltgrass and wheatgrass in the saline areas.

Trees grew on the steeply sloping areas and in the narrow flood plains along meandering streams. Bur oak generally grew on the steep slopes, and elm, ash, cottonwood, and boxelder grew in the low areas. Native fruits and berries provided food to the Indians.

Transportation

Several railroads that cross the county provide good connections to grain and livestock terminals in Omaha, Kansas City, and Denver. Rail passenger service is supplied throughout the county. Several major airlines and a number of smaller airlines serve the county from the airport at Lincoln.

Interstate 80, U.S. Highways 6 and 34, and State Highway 2 cross the county from east to west, and U.S. Highway 77 traverses the county from north to south. State Highway 43 crosses the southeast corner of the county, State Highway 33 crosses the southwest corner, and State Highway 79 crosses the northwest corner.

The rural road system is well developed. Roads are generally on section lines and are paved or gravelled, or they are improved dirt roads. Rural mail routes reach all parts of the survey area.

Manufacturing

Lancaster County is an important center of retail and wholesale trade. In the past decade, many manufacturing plants have moved into Lancaster County, and industries already established have expanded their facilities. Manufactured products include boxes and containers, commercial business forms, electrical equipment, foodstuffs, machinery and machine tools, pharmaceuticals, rubber products, motorcycles, and commercial vehicles.

Farming

According to Nebraska Agricultural Statistics, there were 1,670 farms in Lancaster County in 1974 and 1975. In 1970, there were 1,750 farms, and in 1965, there were 1,820 farms. These figures are consistent with the downward trend in the number of farms throughout the country. The enlargement of farms and urban expansion into farmland accounts for this trend.

The number of dairy and beef cattle, hogs, sheep, and chickens raised between 1970 and 1975 decreased, and there was considerable reduction in pounds of milk produced, beef cattle fed, and eggs sold.

Use of irrigation has increased in the county; however, only a very small percentage of farmed land is irrigated. The number of wells used for irrigation purposes increased from 129 in 1973 to 161 in 1975. Irrigated acreage increased from 11,900 acres in 1973 to 15,000 acres in 1975.

Owing to increasing cost and better management practices, the use of fertilizer has decreased. Over 17,000 tons of fertilizer were used in 1970-71; about 15,000 tons were used in 1974-75.

Grain sorghum is the most important crop in Lancaster County. Wheat, corn, soybeans, and hay are also grown. Between 1971 and 1975, the acreage in grain sorghum harvested somewhat decreased, and the acreage in wheat and corn increased. The acreage in soybeans almost tripled. Hay acreage dropped. The yield per acre of all crops showed substantial decrease during this period, probably because these years were droughty.

School facilities

Lancaster County has numerous elementary, junior high, and high schools. There are also several trade and business schools in the county. The University of Nebraska-Lincoln, Nebraska Wesleyan University, and Union College are in Lincoln.

Geology

The bedrock in Lancaster County is Pennsylvanian and Permian age limestone with interbedded shale and shaley limestone, and interbedded shale and sandstone of the Dakota Group of Cretaceous age.

Material of Pennsylvanian age forms the bedrock beneath Salt Creek Valley in an area extending from Lincoln northeast to the county line and along the northeastern edge of the county. Material of Permian age forms the bedrock south and east of a line passing through the towns of Sprague and Walton. Limestone of the Council Grove Group has been quarried south and east of Bennett and is presently quarried near Roca.

The Dakota Group forms the bedrock north and west of a line passing through Sprague and Walton except for that part of Salt Creek Valley northeast of Lincoln. Numerous small outcrops of rusty brown Dakota sandstone

are southwest of Lincoln, north of Lincoln along Little Salt Creek, and north of Waverly along Rock Creek. The "Indian Monument" in Lincoln's Pioneer Park is exposed Dakota sandstone and shale.

Unconsolidated sediment of Quaternary age overlies the bedrock in the county. The light gray silts of the Fullerton Formation, late Nebraskan in age, crop out at numerous sites west and north of Lincoln. Glacial till of Kansan age is at the surface in western, northern, and central Lancaster County. It is moderately clayey till that contains a few granite and quartize boulders, some cobbles, and numerous pebbles. The Illinoian age sediment consists of clayey to sandy alluvial materials and Loveland Loess. Peorian Loess covers much of the county and is the principal parent material for the soils. It is pale brown, slightly clayey silt in the upper part grading to gray clayey silt that has rusty brown iron and manganese mottles and concretions.

The flood plain deposits within the valleys are recent accumulations of dark, silty to clayey sediment washed from nearby uplands. Most of the small valleys are flooded several times each year. The large valley flood plains are flooded two or three times in a 10-year period. Each flood deposits more material, and in most valleys this dark soil material is several feet thick.

Ground water

Wells in Lancaster County provide water for domestic, livestock, and industrial use, and, in places, for irrigation. Limestone of Pennsylvanian and Permian age, sandstone of the Dakota Group of Cretaceous age, and unconsolidated sediments of Quaternary age are sources of ground water.

The Pennsylvanian and Permian rocks generally are a poor source of water. Most wells tapping these rocks have low yields, and the water commonly has too many minerals for satisfactory use.

The sandstone layers of the Dakota Group are moderately permeable, and those layers that are saturated generally yield water for wells. These rocks are an important source of water for domestic and industrial use and, in a few places, they supply water for irrigation. However, in some parts of the county, the water in the Dakota rocks is too salty for most uses. The Dakota Formation is absent southeast of a line passing through Sprague and Walton and beneath that part of Salt Creek Valley northeast of Lincoln.

Unconsolidated sediments of Quaternary age consist of till and other glacial deposits, wind deposited silt, and stream alluvium. The alluvium is the only significant source of water. It underlies the terraces and bottom lands in the larger valleys and fills some ancient buried valleys. Where the alluvium consists largely of sand or sandy gravel, as in the lower Salt Creek Valley, water can be obtained in sufficient amount for irrigation. In other places, yields are generally high enough for domestic and livestock use. The water is generally of good quality, but in some wells the mineral content exceeds acceptable limits for certain uses.

The sand lenses and pockets of sand and gravelly sand in the glacial deposits are a source of small quantities of water for domestic use and stock wells. Many farm wells in the county are dependent upon this limited and somewhat unreliable source. Quality ranges from hard but good water, to very hard water where the content of sulphate and iron commonly exceeds acceptable limits for use.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Lancaster County is cold in winter and is quite hot with occasional cool spells in summer. During the winter, precipitation frequently occurs as snowstorms. During the warm months, when warm moist air moves in from the south precipitation is chiefly showers, which are often heavy. Total annual rainfall is normally adequate for grain sorghum and small grains, but it is frequently slightly insufficient for corn and soybeans.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Lincoln in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Lincoln on January 29, 1966, is -18 degrees. In summer the average temperature is 76 degrees, and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred on August 2, 1964, is 107 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation 22 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.86 inches at Lincoln on July 1, 1957. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 28 inches. The greatest snow depth at any one time during the period of record was 21 inches. On an average of 24 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average

at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration, and result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Sharpsburg-Pawnee-Burchard association

Deep, gently sloping to steep, moderately well drained and well drained, silty soils that formed in loess and loamy soils that formed in glacial till; on uplands

This association is made up of soils on upland divides and side slopes. The divides are gently sloping, and the side slopes are strongly sloping to steep (fig. 1).

This association makes up 53,990 acres or about 10 percent of the county. About 30 percent is Sharpsburg soils; 26 percent, Pawnee soils; 15 percent, Burchard soils; and 29 percent, minor soils.

The Sharpsburg soils mainly are on upland divides and the upper part of side slopes. They are moderately well drained soils that formed in loess. The surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, firm silty clay; the middle part is brown, firm silty clay; the lower part is yellowish brown, firm or friable silty clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown silty clay loam.

The Pawnee soils are on side slopes. They are moderately well drained soils that formed in glacial till. They have a very dark brown, friable clay loam surface layer about 7 inches thick. The subsoil is about 31 inches thick. It is very dark grayish brown, firm clay in the upper part; dark grayish brown in the next part; olive brown, very firm clay in the next part; and olive gray, firm clay in the lower part. It has few to many yellowish brown mottles. The underlying material, to a depth of 60 inches, is olive, calcareous clay loam.

The Burchard soils are on strongly sloping to steep side slopes. They are well drained soils that formed in

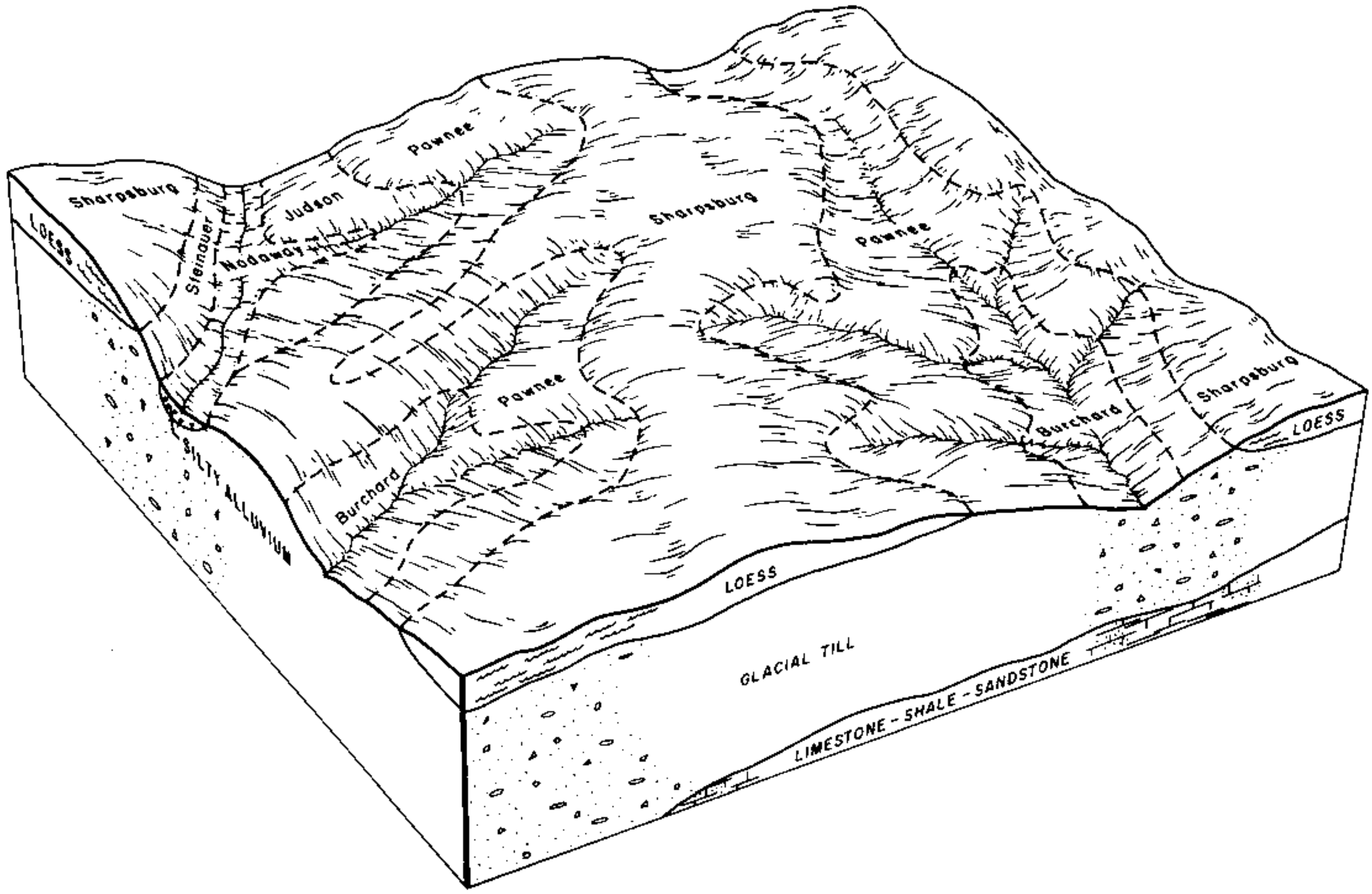


Figure 1.—Relationship of soils in the Sharpsburg-Pawnee-Burchard association.

glacial till. They have a very dark brown, friable clay loam surface layer about 8 inches thick. The subsoil is firm clay loam about 25 inches thick. The upper part is dark brown and dark grayish brown; and the lower part is grayish brown with medium distinct yellowish brown mottles and many large soft accumulations of lime. The underlying material is light brownish gray clay loam that has common distinct yellowish brown mottles and many small soft accumulations of lime.

Of minor extent are the Judson, Morrill, Nodaway, Shelby, and Steinauer soils. Judson soils are on colluvial foot slopes. Morrill soils formed in reddish glacial material and are on side slopes. Nodaway soils are on bottoms along drainageways where flooding is common. Shelby soils are on lower side slopes below the Burchard and Pawnee soils. Steinauer soils are on strongly sloping to steep side slopes.

The soils in this association are used for cash grain farming. Farms are about 320 acres. Grain sorghum and wheat are the main crops. A small acreage of soybeans, corn, and other crops is also grown. Some areas of steeper soils are used for pasture and range. Most crops are dryfarmed. Irrigation is impractical because of the absence of an adequate water supply and slope.

Water erosion is the main hazard in cultivated areas. In some years, inadequate rainfall limits crop production.

Gravelled or improved dirt roads are on most section lines, and some paved highways cross the area. Grain grown for cash sale is sold mainly to local elevators, but some grain is used on farms to fatten cattle and hogs. Fattened cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are generally severely limited for septic tank absorption fields because of slow or moderately slow permeability or slope. They are severely limited for sewage lagoons because of slope. Most of the soils are limited for building sites because of

high shrink-swell and for roads and streets because of high frost action.

2. Sharpsburg-Judson association

Deep, nearly level to moderately steep, moderately well drained, silty soils that formed in loess and colluvium; on uplands and foot slopes

This association is made up of soils on alternating divides, side slopes, and foot slopes of uplands. It includes a few soils on bottom lands and stream terraces adjacent to steep slopes (fig. 2). Soils on the divides are nearly level to gently sloping. Soils on the side slopes are gently sloping to moderately steep. Soils on the colluvial foot slopes are gently sloping.

This association makes up 151,096 acres, or about 28 percent of the county. Approximately 70 percent is Sharpsburg soils; 10 percent, Judson soils; and 20 percent, minor soils and miscellaneous areas.

The Sharpsburg soils are on divides and side slopes. They formed in loess. The surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, firm silty clay; the middle part is brown, firm silty clay; the lower part is yellowish brown, firm or friable silty clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown silty clay loam.

The Judson soils are on colluvial foot slopes. They formed in silty colluvium. The surface layer is about 29 inches thick. The upper part is very dark brown, friable silt loam; the next part is black, friable silt loam; the next part is very dark brown, friable silty clay loam; the lower part is very dark grayish brown, friable silty clay loam. The subsoil is dark brown, firm silty clay loam about 26

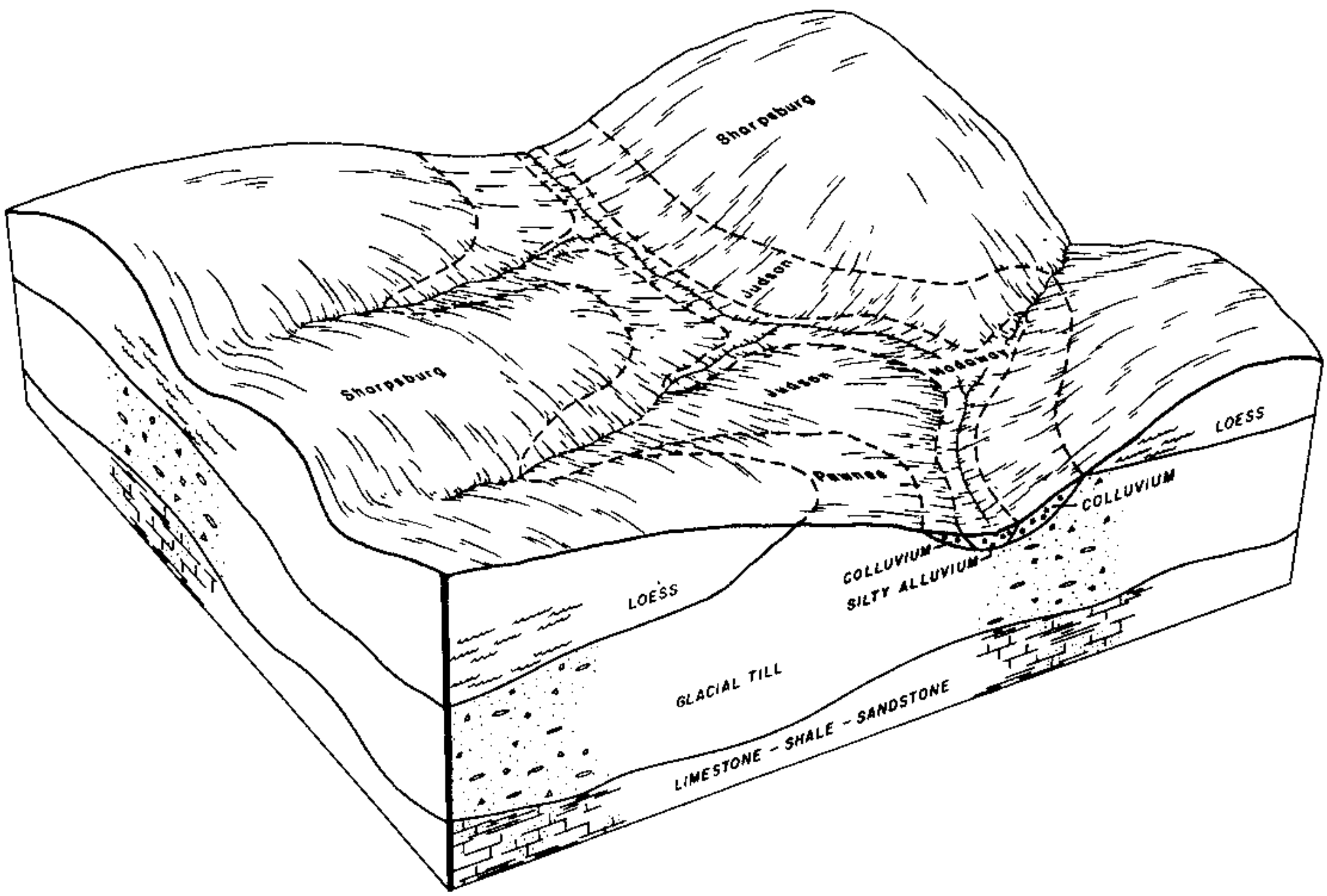


Figure 2.—Relationship of soils in the Sharpsburg-Judson association.

inches thick. The underlying material, to a depth of 60 inches, is brown silty clay loam.

Of minor extent are Mayberry, Nodaway, Pawnee, and Wymore soils and miscellaneous areas of Urban land. Mayberry, Pawnee, and Wymore soils are gently sloping to strongly sloping. They are on lower side slopes. Nodaway soils are nearly level and are sometimes channeled. They are on bottoms of upland drainageways. Urban land consists of nearly level to moderately steep land that is covered by streets, parking lots, and structures. The Judson, Mayberry, Pawnee, Sharpsburg, and Wymore soils are associated with Urban land in complexes.

The soils in this association are used mainly for cash grain farming. Farms average about 300 acres. Grain sorghum and wheat are the principal crops. A small acreage of soybeans and alfalfa is also grown.

Water erosion is the main hazard. In some years inadequate rainfall limits the production of dryfarmed crops. Ground water supplies are generally insufficient for irrigation.

Gravelled or improved dirt roads are on most section lines. Grain grown for cash sale is sold mainly to local elevators, but some grain is used on farms for feed. Fattened cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

Soils in this association are generally moderately to severely limited for septic tank absorption fields and sewage lagoons because of slow to moderate permeability and slope. The soils are limited for building sites and roads and streets because of high shrink-swell and high frost action.

3. Kennebec-Nodaway-Zook association

Deep, nearly level and very gently sloping, moderately well drained to poorly drained, silty soils that formed in alluvium; on flood plains

This association is made up of soils on flood plains along major drainageways (fig.3).

This association makes up 59,516 acres or about 11 percent of the county. About 37 percent is Kennebec

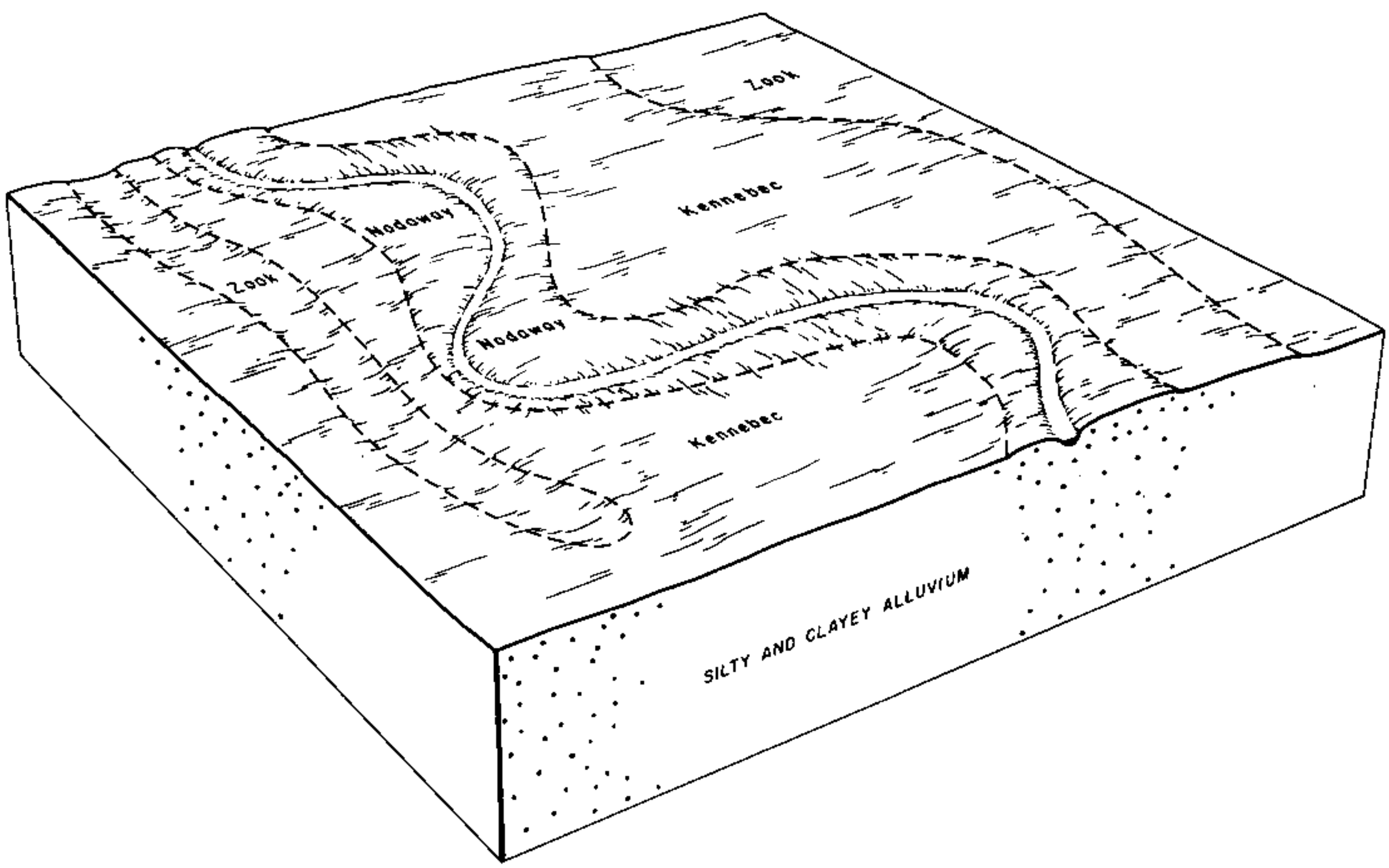


Figure 3.—Relationship of soils in the Kennebec-Nodaway-Zook association.

soils; 18 percent, Nodaway soils; 12 percent, Zook soils; and 33 percent, minor soils and miscellaneous areas.

The Kennebec soils are nearly level and are moderately well drained. These soils are on bottom lands adjacent to drainageways. The surface layer is about 56 inches thick. It is black or very dark gray, friable silt loam in the upper part and black, firm silty clay loam in the lower part. The transitional layer is very dark gray, firm silty clay loam about 16 inches thick.

The Nodaway soils are nearly level to very gently sloping and are moderately well drained. These soils are dissected by streams. The surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The underlying material, to a depth of 60 inches, is very dark grayish brown. It is stratified silt loam in the upper 45 inches, and beneath that depth it is silty clay loam.

The Zook soils are nearly level and are somewhat poorly drained or poorly drained. These soils are on low areas of flood plains and commonly are at a distance from the main stream channel. In places, they are dissected by the tributary channels which dissect the flood plains. The surface layer is silty clay loam about 26 inches thick. The upper part is very dark gray and friable, the middle part is black and friable, and the lower part is very dark gray and firm. The subsoil, to a depth of 60 inches, is silty clay. The upper part is very firm and black, and the lower part is firm and very dark gray.

Of minor extent are Colo, Lamo, Salmo, and Wabash soils and miscellaneous areas of Urban land. Colo soils are somewhat poorly drained or poorly drained, nearly level, and occasionally or frequently flooded. Lamo soils are somewhat poorly drained, nearly level, occasionally flooded, and are calcareous. Salmo soils are poorly drained or somewhat poorly drained, nearly level, and are slightly to moderately affected with salts. Urban land consists of land covered by streets, parking lots, and structures. The Colo, Kennebec, and Zook soils are associated with Urban land. The slope is nearly level. Wabash soils are poorly drained and nearly level.

The soils in this association are mainly used for cash grain farming. Farms average about 320 acres. Grain sorghum and corn are the principal crops. Some soils are irrigated if ground water or streamflow is adequate.

Flooding is the main hazard. During years of more than normal precipitation, flooding is common.

Gravelled or improved dirt roads are on most section lines. Grain grown for cash sale is sold mainly to local elevators, but some grain is used on farms for feed. Fattened cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

Soils in this association are severely limited for sanitary facilities because of the hazard of flooding. They have severe limitations for building sites because of the flooding hazard, and for roads and streets because of the flooding hazard and frost action.

4. Crete-Sharpsburg association

Deep, nearly level to gently sloping, moderately well drained, silty soils that formed in loess; on stream terraces

This association is made up of soils on stream terraces along Salt Creek and Oak Creek drainageways.

This association makes up 21,642 acres or about 4 percent of the county. About 48 percent is Crete soils; 22 percent, Sharpsburg soils; 18 percent, Urban land; and 12 percent, minor soils.

The Crete soils are nearly level to gently sloping. They are in the lower part of the association. The surface layer is about 14 inches thick. The upper part is very dark brown, friable silt loam and the lower part is black, friable silty clay loam. The subsoil is about 27 inches thick. The upper part is very dark grayish brown, very firm silty clay; the middle part is brown, very firm silty clay; and the lower part is brown, firm silty clay loam. The underlying material, to a depth of 60 inches, is pale brown. The upper part is silt loam that has a few fine distinct reddish brown mottles.

The Sharpsburg soils are nearly level. They are in the higher part of the association. The surface layer generally is friable silty clay loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark gray. The subsoil is firm silty clay loam about 29 inches thick. The upper third is very dark grayish brown and the lower part is brown. The underlying material, to a depth of 60 inches, is silty clay loam. The upper part is brown, and the lower part is pale brown.

Of minor extent are Butler, Fillmore, and Nodaway soils. Butler and Fillmore soils are nearly level. They are in shallow depressions and in more nearly level areas on stream terraces. Nodaway soils are nearly level or very gently sloping. They are in areas which are dissected by deeply entrenched, meandering streams.

The soils in this association are used mainly for cash grain farming. Farms average about 320 acres. Grain sorghum, corn, and wheat are the principal crops. A small acreage of soybeans is also grown. Most of the crops are dryfarmed; however, near Waverly some crops are irrigated because ground water is adequate. In some years, production of dryfarmed crops is limited by inadequate rainfall.

Gravelled or improved dirt roads are on most section lines. Grain grown for cash sale is sold mainly to local elevators, but some grain is used on farms for feed. Fattened cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are severely limited for septic tank absorption fields because of slow or moderately slow permeability. They are suited to sewage lagoons in some areas, but slope is a limitation in other areas. These soils have severe limitations for building sites because of high shrink-swell, and for roads and streets because of shrink-swell and high frost action.

5. Steinauer-Pawnee-Burchard association

Deep, gently sloping to very steep, well drained and moderately well drained, loamy and clayey soils that formed in glacial till; on uplands

This association is made up of soils on narrow divides, side slopes, and bottom lands along upland drains. The soils on divides are gently sloping and those on the side slopes are strongly sloping to very steep (fig. 4).

This association makes up 18,674 acres, or about 3 percent of the county. About 27 percent is Steinauer soils; 18 percent, Pawnee soils; 17 percent, Burchard soils; and 38 percent, minor soils.

The Steinauer soils are on strongly sloping to very steep side slopes. They are well drained. The surface layer is friable, very dark grayish brown loam about 5 inches thick. The transitional layer is friable, brown loam about 7 inches thick. The upper part of the underlying material is yellowish brown loam and the lower part is light olive brown clay loam. This soil is generally calcareous in all parts of the profile.

The Pawnee soils are on gently sloping narrow divides and on gently to strongly sloping side slopes. They are moderately well drained. The surface layer is very dark brown, friable clay loam or clay about 7 inches thick. The subsoil is about 31 inches thick. It is very dark grayish brown, firm clay in the upper part; dark grayish brown and very firm in the next layer; olive brown and very firm in the next layer; and olive gray, firm clay in the lower part. It has few to many yellowish brown mottles. The underlying material, to a depth of 60 inches, is olive, calcareous clay loam.

The Burchard soils are on strongly sloping to steep side slopes. They are well drained. The surface layer is very dark brown, friable clay loam about 8 inches thick.

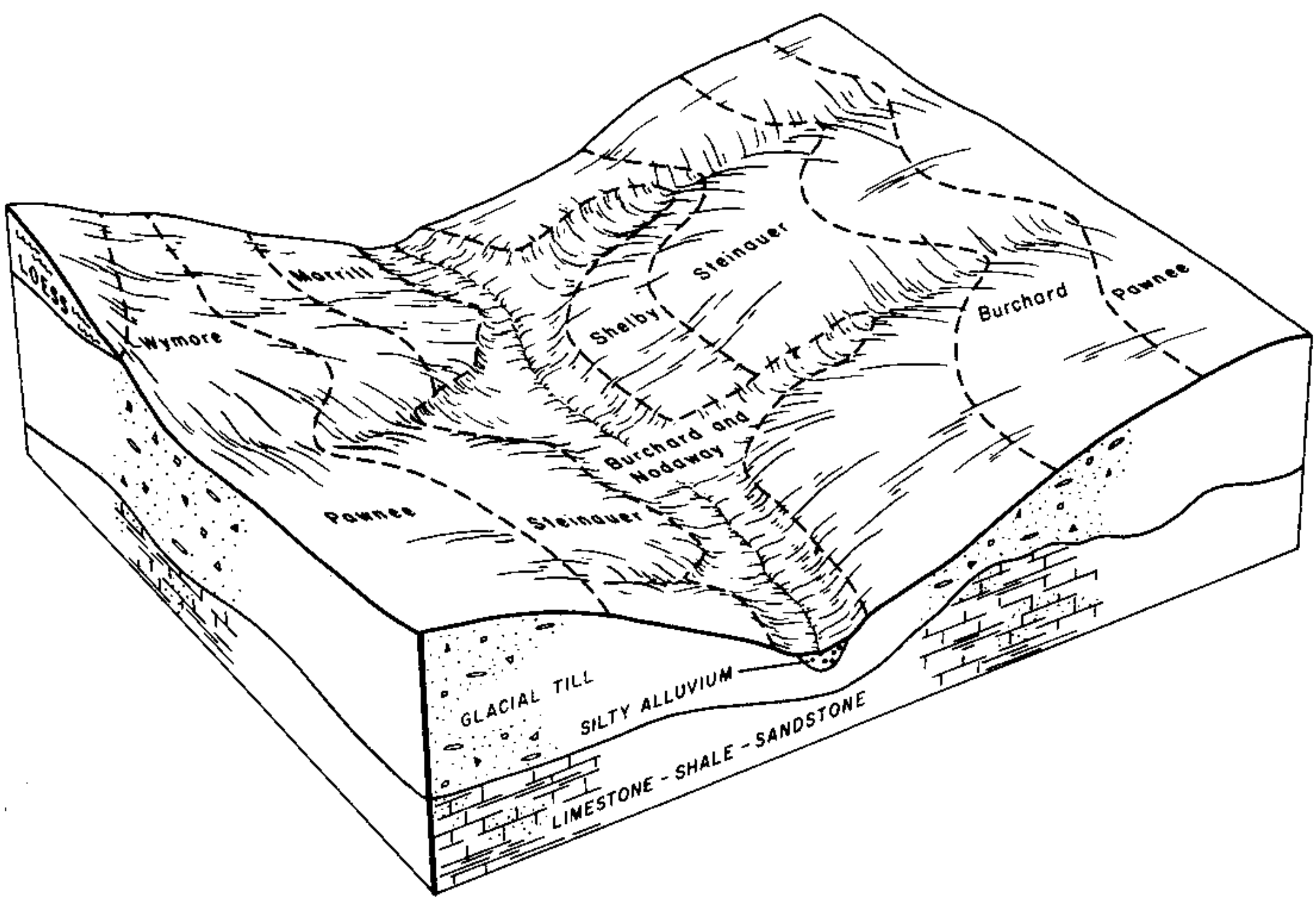


Figure 4.—Relationship of soils in the Steinauer-Pawnee-Burchard association.

The subsoil is firm clay loam about 25 inches thick. The upper part is dark brown and dark grayish brown, the middle layer is brown, and the lower part is grayish brown with many medium distinct yellowish brown mottles and many large soft accumulations of lime. The underlying material is light brownish gray clay loam with common medium distinct yellowish brown mottles and many small soft accumulations of lime.

Of minor extent are Dickinson, Judson, Mayberry, Morrill, Nodaway, Shelby, and Wymore soils. Dickinson soils are on side slopes and narrow divides and are sandy. Judson soils are on colluvial foot slopes. Mayberry soils are on narrow divides and side slopes and are of redder hue than Pawnee soils. Morrill soils are on ridges and side slopes. Nodaway soils are on bottom lands of upland drainageways. Shelby soils are on lower side slopes below the Burchard and Steinauer soils. Wymore soils are on upper side slopes and divides higher than the Pawnee and Burchard soils.

The soils in the association are used for diversified farming, but farming is mostly of the cash grain-livestock type. Soils on the divides are used mainly for dryfarmed crops. Grain sorghum and wheat are the main crops. Strongly sloping to very steep soils are used for pasture and range.

Water erosion in cultivated areas and overgrazing in range areas are the main hazards. In some years, production of dryfarmed crops is limited by inadequate rainfall.

Gravelled or improved dirt roads are on most section lines. Some paved highways cross the area. Grain grown for cash sale is sold mainly to local elevators. Cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are severely limited for sanitary facilties because of slow or moderately slow permeability and slope. They are severely limited for building sites because of moderate to high shrink-swell and for roads and streets because of frost action and slope.

6. Wymore-Pawnee association

Deep, nearly level to strongly sloping, moderately well drained, silty soils that formed in loess and loamy soils that formed in glacial till; on uplands

This association is made up of soils on narrow divides, on bottom lands, and on side slopes along upland drains. Soils on the divides are nearly level to gently sloping and those on the side slopes are gently sloping to strongly sloping (fig. 5).

This association makes up 189,370 acres, or about 34 percent of the county. About 51 percent is Wymore soils; 19 percent, Pawnee soils; and 30 percent, minor soils.

The Wymore soils are on divides and side slopes. The surface layer is very dark brown, firm silty clay loam about 8 inches thick. In about 35 percent of the areas mapped it is silty clay. The subsoil is about 30 inches thick. The upper part is dark brown, firm silty clay; the middle part is dark grayish brown, firm silty clay; the lower part is olive brown, friable silty clay loam that has a few medium accumulations of lime. The underlying material, to a depth of 60 inches, is olive gray silty clay loam with many small accumulations of lime.

The Pawnee soils are on gently sloping or strongly sloping side slopes. The surface layer is very dark brown, friable clay loam or clay about 7 inches thick. The subsoil is about 31 inches thick. It is very dark grayish brown, firm clay in the upper part; dark grayish brown, very firm clay in the next layer; and olive gray, firm clay in the lower part. It has few to many yellowish brown mottles. The underlying material, to a depth of 60 inches, is olive, calcareous clay loam. Ten to 20 percent of each mapped area is severely eroded and has the clay subsoil exposed at the surface.

Of minor extent are Judson, Mayberry, Morrill, Nodaway, and Sharpsburg soils. Judson soils are nearly level to gently sloping. They are on colluvial foot slopes. Mayberry soils are on side slopes. They formed in glacial material and are of redder hue than Pawnee soils. Morrill soils are on side slopes. They formed in glacial material and are not as fine textured as Pawnee soils. Nodaway soils are on bottom lands of upland drainageways and on frequently flooded bottom lands that have deeply entrenched, meandering channels. Sharpsburg soils are on divides and side slopes. They formed in loess and have less clay in the subsoil than Wymore soils.

The soils in this association are used mainly for cash grain farming. Farms average about 320 acres. Grain sorghum and wheat are the principal crops; however, soybeans and alfalfa are also grown. Most of the crops are dryfarmed because ground water supplies are generally inadequate for irrigation.

Water erosion is the main hazard. Inadequate rainfall limits production of dryfarmed crops in some years.

Gravelled or improved dirt roads are on most section lines. Grain grown for cash is sold mainly to local elevators, but some grain is used on the farms for feed. Cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are severely limited for septic tank absorption fields because of slow permeability and slope. They are severely limited for sewage lagoons because of slope. The soils are severely limited for building sites because of high shrink-swell and for construction of roads and streets because of high shrink-swell and high frost action.

7. Crete-Wymore-Butler association

Deep, nearly level and very gently sloping, moderately well drained and somewhat poorly drained, silty soils that formed in loess; on uplands

This association is made up of nearly level and very gently sloping soils on divides.

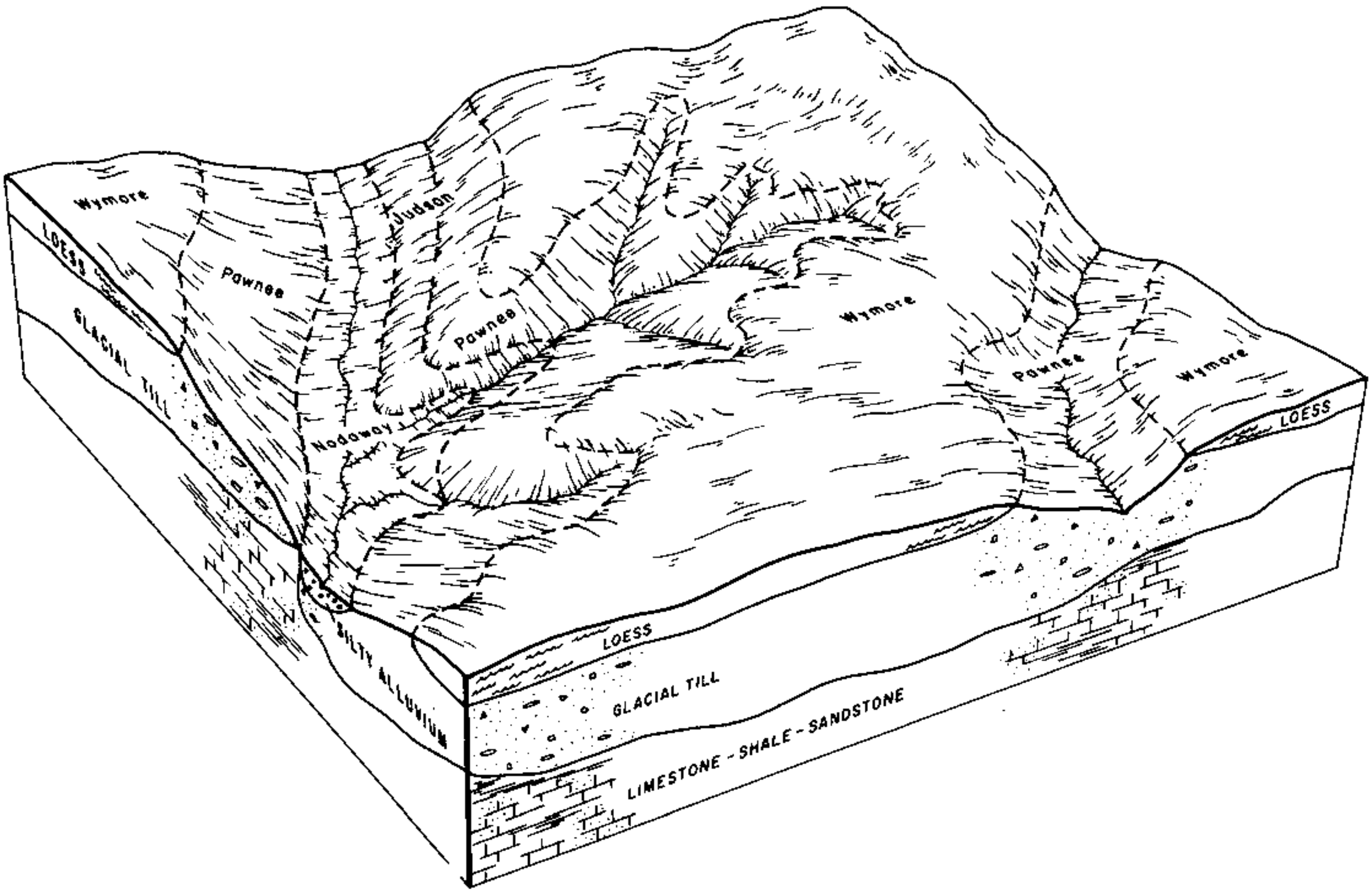


Figure 5.—Relationship of soils in the Wymore-Pawnee association.

This association makes up 16,231 acres, or about 3 percent of the county. About 57 percent is Crete soils; 30 percent, Wymore soils; 12 percent, Butler soils; and 1 percent, minor soils.

The Crete soils are on broad divides. The surface layer is about 13 inches thick. It is black, friable silt loam in the upper part and black, friable silty clay loam in the lower part. The subsoil is about 26 inches thick. The upper part is very dark grayish brown, firm silty clay; the next layer is dark brown, very firm silty clay; the next layer is dark grayish brown, very firm silty clay; the lower part is dark grayish brown, firm silty clay loam that has common fine distinct strong brown mottles. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam that has common fine distinct strong brown mottles in the upper part and many large distinct yellowish brown mottles in the lower part. Soft accumulations of carbonates are present.

The Wymore soils are on narrow ridgetops. The surface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is dark grayish brown, silty clay; and the lower part is dark grayish brown, firm silty clay that has lime concretions. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam that has soft accumulations of carbonates.

The Butler soils are in shallow depressions and in lower areas of broad divides. The surface layer is black, friable silt loam about 10 inches thick. The subsurface layer is very dark gray, very friable silt loam about 2 inches thick. The subsoil is about 31 inches thick. The upper part is black, very firm silty clay; the middle part is very dark grayish brown, very firm silty clay; the lower part is olive gray, firm silty clay loam that has a few fine distinct yellowish brown mottles. The underlying material,

to a depth of 60 inches, is olive silty clay loam that has common medium distinct strong brown mottles.

Of minor extent are the Fillmore soils. They are in shallow depressions or in the lower areas.

The soils in this association are used mainly for cash grain farming. Farms average about 320 acres. Grain sorghum and wheat are the principal crops; however, some corn is grown in irrigated areas. Ground water for limited irrigation is available in areas near Hallam, Princeton, and Firth. In some years, production of dryfarmed crops is limited by inadequate rainfall.

Gravelled or improved dirt roads are on most section lines. Grain grown for cash is sold mainly to local elevators, but some grain is used on farms for feed. Cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are generally severely limited for septic tank absorption fields because of slow permeability. Some areas are severely limited because of wetness. The soils are suited to sewage lagoons; however, in depressional areas they are severely limited because of wetness. These soils are severely limited for building sites because of high shrink-swell and wetness in the depressional areas. They are severely limited for roads and streets because of high shrink-swell and high frost action.

8. Pawnee-Burchard association

Deep, gently sloping to steep, moderately well drained and well drained, loamy and clayey soils that formed in glacial till; on uplands

This association is made up of soils on ridges and side slopes of the uplands. Soils on the ridges are gently sloping to strongly sloping, and those on the side slopes are moderately steep to steep.

This association makes up approximately 37,017 acres, or about 7 percent of the county. About 55 percent is Pawnee soils; about 35 percent, Burchard soils; and 10 percent, minor soils.

The Pawnee soils are on narrow ridges and side slopes of uplands. They are moderately well drained. The surface layer is very dark brown, friable clay loam or clay about 7 inches thick. The clay subsoil is about 31 inches thick. It is very dark grayish brown in the upper part; dark grayish brown and olive brown in the middle part; and olive gray in the lower part. It contains few to many yellowish brown mottles. The underlying material, to a depth of 60 inches, is olive, calcareous clay loam.

The Burchard soils are on lower side slopes. They are well drained. The surface layer is very dark brown, friable clay loam about 8 inches thick. The subsoil is firm clay loam about 25 inches thick. It is dark brown and dark grayish brown in the upper part and grayish brown with many medium distinct yellowish brown mottles and many large soft accumulations of lime in the lower part.

Of minor extent are Mayberry, Nodaway, Judson, and Steinauer soils. The gently sloping to strongly sloping Mayberry soils are on upper side slopes and narrow divides. They are of redder hue than Pawnee soils. The nearly level Nodaway soils are on bottoms of upland drainageways. Judson soils are on colluvial foot slopes. The strongly sloping to very steep Steinauer soils are on nose slopes.

The soils in this association are used mostly for cash grain and livestock farming. Soils on the divides and in the well drained drainageways are used mainly for dryland farming. Grain sorghum and wheat are the main crops. Strongly sloping to very steep soils are used for pasture and range.

Water erosion in cultivated areas and overgrazing in pasture and range areas are the main hazards. In some years, production of dryfarmed crops is limited by inadequate rainfall.

Gravelled or improved dirt roads are on most section lines. Some paved highways cross the area. Grain grown for cash sale is sold mainly to local elevators. Cattle and hogs are marketed at Omaha stockyards or at local auctions, or they are sold directly to packers.

The soils in this association are generally severely limited for septic absorption fields because of slow or moderately slow permeability and slope. They are severely limited for sewage lagoons because of slope. These soils are severely limited for building sites because of high shrink-swell or slope and for roads and streets because of high shrink-swell and high frost action.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in

slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Sharpsburg silty clay loam, 2 to 5 percent slopes, is one of several phases in the Sharpsburg series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Colo-Nodaway silty clay loams, 0 to 2 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Lancaster County Soil Survey joins three published soil surveys: Saunders County to the north, Seward County to the west, and Gage County to the south. It is similar to those published surveys in kinds of soils, slopes, and interpretations. However, in several instances, names of these soils are different. This is accounted for by differences between Ustolls and Udolls, the small acreage of some units, and a difference in concepts concerning the naming of map units over a period of time.

BpF—Burchard-Nodaway complex, 2 to 30 percent slopes. This complex consists of moderately steep or steep, well drained soils on side slopes and very gently sloping, moderately well drained soils on bottom lands along drainageways of uplands. From 25 to 55 percent of the complex is Burchard soils and from 20 to 40 percent is Nodaway soils. Areas are long and narrow and range from 5 to 75 acres. Burchard soils are on side slopes. Nodaway soils are on frequently flooded bottom lands that are dissected by deeply entrenched channels. The two soils are so intricately mixed or areas are so small that it is not practical to separate them in mapping. Some unvegetated loess is on the side slopes.

Typically, the Burchard soil has a surface layer of very dark brown, friable clay loam about 10 inches thick. The subsoil is firm clay loam about 22 inches thick. The upper part is dark brown; the middle part is dark yellowish brown; and the lower part is mixed yellowish brown and grayish brown. The underlying material, to a depth of 60 inches, is grayish brown, calcareous clay loam.

Typically, the Nodaway soil, to a depth of 60 inches, is very dark grayish brown silt loam that has strata of light colored material. In places, the strata are silty clay loam.

Included in this complex are small areas of Colo, Pawnee, and Steinauer soils. The calcareous Steinauer soils are on steep side slopes in places. Pawnee soils are on side slopes and have a clay subsoil. The somewhat poorly drained Colo soils are on bottom lands. These soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Burchard soil and moderate in the Nodaway soil. Available water capacity is high in both soils. Runoff is slow on the Nodaway soil and rapid on the Burchard soil. Both soils release moisture readily to plants, and have moderate content of organic matter. Natural fertility is high in the Nodaway soil and medium in the Burchard soil. Typically, the high water table is at a depth of 3 to 5 feet in the Nodaway soil.

Most of the acreage in this complex is in native grass and trees and is used for grazing. These soils have fair potential for grass and good potential for wildlife habitat. They have poor potential for cultivated crops and for most engineering uses. The potential for planting tree windbreaks is very poor because the slope is too steep for mechanical planters.

In many areas there is very little grass because these soils are covered with trees or the area is dissected by entrenched stream channels. The trees provide shelter for livestock.

This complex is not suited to planting of windbreaks; however, shrubs and trees can be planted by hand to develop or improve habitat for wildlife. Chokecherry, Nanking cherry, and American plum are suitable for planting. Many kinds of plants that grow on these soils provide food and shelter for deer, bobwhite quail, squirrels, and numerous species of birds. In many places, dams have been built which benefit both livestock and wildlife. Ponds provide habitat for ducks, muskrat, and beaver.

Few structures other than dams are built on these soils. The complex slopes and flooding cause severe limitations for most engineering uses. If roads are constructed across these areas, a large amount of fill material is needed. Potential pond reservoir sites are plentiful.

This complex is in capability unit VIe-1 dryland; Burchard soil is in Silty range site and Nodaway soil is in Silty Overflow range site. The windbreak suitability group is 10.

BrD—Burchard clay loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on narrow ridgetops and side slopes of uplands. Many pebbles and a few stones are on the surface. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the surface layer is very dark brown, friable clay loam about 8 inches thick. The subsoil is firm clay loam about 25 inches thick. The upper part is dark brown, very dark grayish brown, and brown; and the lower part is grayish brown with many yellowish brown mottles and many large soft accumulations of lime. The underlying material is light brownish gray clay loam that has yellowish brown mottles and many small soft accumulations of lime. In a few areas, the surface layer is less than 7 inches thick because of erosion by water. In a few places, the soils do not have carbonates above a depth of 40 inches.

Included with this soil in mapping are small areas of Mayberry, Pawnee, and Steinauer soils. Mayberry and Pawnee soils are moderately well drained and have finer textured subsoils than Burchard soils. The Mayberry soils are on the upper part of side slopes and are higher than Burchard soils. The Pawnee soils are at the heads of drainageways and on lower side slopes. The calcareous Steinauer soils are on the steeper parts of the map unit on side slopes. These soils make up 10 to 15 percent of the map unit.

This Burchard soil has moderately slow permeability. Runoff is medium or rapid, depending on the amount of plant cover. Natural fertility is medium. Moisture is released readily to plants. This soil is easily worked. Shrink-swell potential is moderate.

About 65 percent of the acreage of this soil is used for cultivated crops, and the rest is mainly in native grass. Very few areas are irrigated. This soil has good potential for cultivated crops and for pasture, range, and windbreaks. The potential is fair for most engineering uses because of slope and the shrink-swell characteristic.

This soil is well suited to alfalfa and wheat. Row crops, for example, grain sorghum, corn, and soybeans, should be limited because of the hazard of erosion. Terraces, grassed waterways, contour farming, and use of crop residue as mulch help to control runoff and erosion. Use of barnyard manure and commercial fertilizer helps to maintain and improve fertility of the soil. This soil has fairly good response to nitrogen if moisture is adequate. It is suited to sprinkler irrigation. The rate of water application should be carefully controlled so that it will not exceed the intake rate. Large stones on the surface need to be removed to prevent damage to cultivation equipment.

Such cool-season grasses as bromegrass and orchardgrass are well adapted to this soil for pasture use. Alfalfa and birdsfoot trefoil can increase the amount of forage in a tame pasture; however, alfalfa can cause bloat in livestock.

This soil is well suited to use as rangeland. Proper grazing and deferred grazing help to maintain a good stand of desirable grasses.

Trees suitable for windbreaks are also suitable for environmental plantings. Shrubs provide habitat for wildlife and are commonly included when tree windbreaks are planted. Planting windbreaks on the contour helps to control erosion. Drought and moisture competition from weeds and grasses are principal hazards.

Buildings with basements commonly need tile drains around the footings to prevent seepage. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. This soil is poorly suited to septic tank absorption fields because of moderately slow permeability and to sewage lagoons because of slope.

Because this soil is erodible, roadbanks need to be planted to a well suited grass or grass mixture and the slope kept to the lowest gradient possible. Placing roads on the contour reduces erosion.

This soil is in capability units IIIe-1 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

BrE—Burchard clay loam, 11 to 15 percent slopes. This deep, moderately steep, well drained soil is on side slopes of uplands. A few pebbles and stones are on the surface. Areas are irregular in shape and range from 3 to 40 acres.

Typically, the surface layer is about 10 inches thick. The upper part is very dark brown, friable light clay loam; the lower part is dark grayish brown, firm clay loam. The subsoil is firm clay loam about 22 inches thick. The upper part is dark brown; the next layer is dark yellowish brown; the next layer is yellowish brown and calcareous; and the lower part is mixed yellowish brown and grayish brown and is calcareous. The underlying material, to a depth of 60 inches, is calcareous, mixed yellowish brown and light brownish gray clay loam. The subsoil and underlying material contain some gravel and a few stones. In a few areas the surface layer is loam. In a few areas, the soils do not have carbonates above a depth of 40 inches.

Included with this soil in mapping are small areas of Steinauer soils. The calcareous Steinauer soils are on the upper part of side slopes. These soils make up about 5 to 10 percent of the map unit.

Permeability is moderately slow in this Burchard soil, and runoff is rapid. Available water capacity is high, and content of organic matter is moderate. Natural fertility is medium. Reaction of the surface layer is medium acid or slightly acid. Tilth is generally good, and the soil is easily tilled through a fairly wide range of moisture content. Shrink-swell potential is moderate.

Most of the acreage of this soil is in native grass and is used for range. A few areas are cultivated. The soil has poor potential for cultivated crops and good potential for wildlife habitat. It has good potential for grass and fair to poor potential for most engineering uses.

This soil is poorly suited to grain sorghum and corn; however, such close growing crops as alfalfa and wheat

have good productivity. If this soil is used for cultivated crops, terraces, contour farming, and grassed waterways are needed to help control erosion. Fertilizer is washed downslope if runoff is not controlled. The soil is generally not suited to irrigation.

Overgrazed rangeland is easily invaded by blue grama, Scribner panicum, and western ragweed. Deferred grazing and planned grazing systems help to maintain and increase desirable plant species and improve the range condition. Distribution of livestock in a pasture can be improved by proper placement of fences and watering and salting facilities. Improved strains of native grasses should be used if the rangeland is reseeded or reestablished. Native grass can be grazed by livestock or cut for hay. Technical help in converting soils that are presently being used for cropland to use for rangeland can be obtained from the local office of the Soil Conservation Service.

Bromegrass and orchardgrass are the most suitable cool-season plants for tame pastures. About 50 percent of the yearly growth needs to be left on the surface after the grazing season to help control water erosion.

This soil provides good sites for trees; however, very few windbreaks are planted. Windbreaks should be placed on the contour to help control erosion.

This soil has severe limitations for building sites. Building sites should be landscaped to conform to the moderately steep terrain. Septic tank absorption fields are not well suited to this soil because the slow percolation rate can cause effluent to rise to the surface. In addition, downslope flow is a problem. Placing roads on the contour reduces erosion.

This soil is in capability unit IVe-1 dryland. It is in Silty range site and windbreak suitability group 4.

Bu—Butler silt loam, 0 to 1 percent slopes. This nearly level, somewhat poorly drained soil is in depressional areas on uplands. It is occasionally flooded and is ponded for periods of short duration. Areas are irregular in shape and range from 3 to 200 acres.

Typically, the surface layer is black, friable silt loam about 10 inches thick. The subsurface layer is very dark gray, very friable silt loam about 2 inches thick. The subsoil is about 31 inches thick. The upper part is black and very dark grayish brown, very firm silty clay; and the lower part is olive gray, firm silty clay loam. The underlying material is olive silty clay loam that has strong brown mottles.

Included with this soil in mapping are small areas of moderately well drained Crete soils and poorly drained Fillmore soils. Crete soils are on the highest part of the map unit. Fillmore soils are in shallow depressions. These soils make up 10 to 20 percent of the map unit.

This Butler soil has slow permeability and slow runoff. Available water capacity is high, and content of organic matter is moderate. Natural fertility is high. Reaction of the surface layer is medium acid or slightly acid. Moisture is released slowly to plants. Depth to the seasonal high water table is 1 foot to 3 feet. Shrink-swell potential is high.

Almost all of the acreage of this soil is used for cultivated crops. A few areas are irrigated. This soil has good potential for cultivated crops and for habitat for openland wildlife. The potential is fair for range, trees, and pasture. The soil has poor potential for most engineering uses because of wetness and the shrink-swell characteristic.

This soil is well suited to alfalfa, wheat, and grain sorghum. It is also suited to corn; however, wetness in spring often delays planting. This soil is droughty during the hottest part of the summer. A cropping system that includes row crops alternating with small grain or alfalfa helps to increase the water intake rate in the subsoil. This soil is suited to both sprinkler and gravity systems of irrigation. More frequent and lighter irrigations are needed if corn is the main crop. Control of flooding from adjacent areas is needed in places. Land leveling permits an even distribution of water from gravity irrigation systems. For sustained crop growth on this soil, extensive use of commercial fertilizers is needed. Lime can be needed, especially if legumes are grown.

Bromegrass, tall fescue, and western wheatgrass are well adapted to this soil for pasture. Use of alfalfa with pasture grass tends to increase forage production. The production of grass generally is increased if the soil is irrigated.

This soil can be reseeded to native grass. If areas are adjacent to cool-season pastures, grazing can be rotated. Range that is grazed during the growing season can be kept in good or excellent condition by leaving about half of the current year's growth.

Trees that tolerate occasional wetness survive and grow well on this soil. Establishment of seedlings is sometimes difficult during wet years. During hot and dry periods, drought and moisture competition from weeds and grasses are hazards.

Residue from grain sorghum and corn left on the ground after harvest provides an excellent supply of food for pheasants, and wheat and alfalfa provide areas for nesting.

This soil generally is not suitable for building sites because of ponding. It is not suited to septic tank absorption fields. Sewage lagoons need to be protected from flooding. Seepage can occur if excavations are more than 3.5 feet deep.

This soil is in capability units IIw-2 dryland and IIw-2 irrigated. It is in Clayey range site and windbreak suitability group 2.

Bw—Butler silt loam, terrace, 0 to 1 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces. It is occasionally flooded and is ponded for periods of short duration. Areas are irregular in shape and range from 3 to 400 acres.

Typically, the surface layer is friable silt loam about 11 inches thick. The upper part is very dark gray and the lower part is black. The subsurface layer is dark gray,

friable silt loam about 2 inches thick. The subsoil is about 27 inches thick. The upper part is black, very firm silty clay; the middle part is very dark brown, extremely firm silty clay; and the lower part is very dark grayish brown, very firm silty clay. The underlying material, to a depth of 60 inches, is olive gray. The upper part is silty clay loam that has a few medium lime concretions and reddish brown mottles. The lower part is silt loam that has many medium distinct reddish brown mottles. Stratified alluvial material is between a depth of 10 to 20 feet. In places the underlying material is slightly affected with soluble salts.

Included with this soil in mapping are small areas of Crete, Fillmore, and Zook soils. The moderately well drained Crete soils are on the highest part of the map unit. Fillmore soils are in shallow depressions, and Zook soils are on the lowest part. Fillmore soils are poorly drained, and Zook soils are poorly drained or somewhat poorly drained. These soils make up 10 to 20 percent of the map unit.

This Butler soil has slow permeability, high available water capacity, and high natural fertility. Runoff is slow, and content of organic matter is moderate. Reaction of the surface layer is medium acid and slightly acid. The surface layer of this soil is easily worked and absorbs water readily, but the fine textured subsoil restricts root development and absorbs water slowly. Depth to the seasonal high water table is 1 foot to 3 feet. Shrink-swell potential is high.

Almost all the acreage of this soil is in cultivated crops, and about 30 percent of the acreage is irrigated. This soil has good potential for cultivated crops and for openland wildlife habitat. The potential is fair for trees, range, and pasture. The soil has poor potential for most engineering uses because of wetness and the shrink-swell characteristic.

If this soil is to be dryfarmed, it is suited to small grain, corn, grain sorghum, and alfalfa. It is best suited to wheat and grain sorghum. The surface layer may stay wet for an extended period of time following rain, particularly in spring. Such wetness delays tillage and can retard the growth of crops in some years. This soil is droughty in summer unless it is irrigated. Keeping the soil covered with a growing crop or with crop residue helps to open the subsoil and aids the movement of water through the soil. Established stands of alfalfa benefit from the ground water which is at a depth of 10 to 20 feet. Because this soil has slow permeability, frequent periods of irrigation are needed. Excessive runoff of irrigation water should be controlled. This soil is suited to both sprinkler and gravity irrigation systems. Applications of barnyard manure or commercial fertilizers are needed to maintain high production.

Bromegrass, tall fescue, and western wheatgrass are most commonly grown in tame grass pastures. Production can be increased by irrigation and applications of fertilizer. However, if production declines, the old stand should be plowed under and the pasture reseeded with desirable grasses.

This soil can be reseeded to native grass. The kind of vegetation that grows well is determined mainly by the slowly permeable, clayey subsoil. Because the soil is droughty during the hottest part of the summer, grass production tends to vary greatly, depending upon annual precipitation. However, many plant species benefit from the ground water which is at a depth of 10 to 20 feet.

This soil generally provides fair sites for windbreaks. Establishment of seedlings is sometimes difficult during wet years. Controlling the abundant and persistent growth of weeds during establishment of trees is a concern of management. Mature trees commonly obtain moisture from ground water. If properly designed and placed, windbreaks can control drifting of snow, provide protection for buildings and livestock, and improve habitat for wildlife.

Residue from grain sorghum and corn left on the ground after harvest supplies food for wildlife. In addition, shrubs planted in windbreaks provide food and cover. Pheasants are common.

This soil is poorly suited to home and other building sites, septic tank absorption fields, and sewage lagoons because of flooding and ponding. Wetness, slow permeability, and high shrink-swell potential are limitations. Ground water and cave-ins are hazards in deep excavations. High or very high corrosivity to uncoated steel pipes occurs in places because of ground water and soluble salts. Coating of buried pipes is needed. Elevation of roadbeds can overcome wetness.

This soil is in capability units IIw-2 dryland and IIw-2 irrigated. It is in Clayey range site and windbreak suitability group 2.

Co—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom lands of major streams. The soil is occasionally flooded. Areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is black, friable silty clay loam about 36 inches thick. The underlying material, to a depth of 60 inches, is very dark gray, friable silty clay loam. In places the underlying material is silty clay below a depth of 40 inches. In some areas, a transitional layer separates the surface layer and underlying material.

Included with this soil in mapping are small areas of Kennebec soils on higher elevations that are better drained than Colo soils. These soils make up 5 to 20 percent of the map unit.

Permeability is moderately slow in this Colo soil, and runoff is slow. Available water capacity is high. Moisture is released readily to plants. The seasonal high water table ranges from a depth of 2 to 3 feet below the surface. Natural fertility is high, and content of organic matter is moderate.

Most areas of this soil are cultivated. This soil has good potential for cultivated crops, grasses, wildlife habitat, and trees for windbreaks. It has poor potential for most engineering uses.

This soil is suited to corn, grain sorghum, and soybeans. Excessive wetness caused by the water table is the principal concern of management because it delays tillage and planting. If suitable outlets are available, tile drains help to lower the water table and control wetness. In dry years, the high water table is beneficial to crops. Terraces, diversion ditches, and grassed waterways on adjacent higher lying soils reduce runoff on this soil and help lessen damage from flooding. Application of lime is needed to neutralize acidity; the amount needed should be determined by soil tests. If underground water is available in adequate quantity, irrigation is feasible. Irrigation is needed mostly to supplement natural rainfall during the dry growing season.

This soil is well suited to reed canarygrass, an introduced cool-season species for range. Overstocking and overgrazing the rangeland causes deterioration of the plant community. When this occurs, the taller more desirable grasses are replaced by less productive short grasses. Distribution of livestock can be improved by proper placement of fences and watering and salting facilities. Grasses that grow on this soil are a dependable source of hay.

This soil provides good sites for tree windbreaks. Weeds and grasses between tree rows can be eliminated by cultivating with conventional equipment, by hand hoeing, or by application of herbicides. Although they are not used for windbreaks, black walnut trees grow fairly well on this soil.

The plants grown on this soil supply food for waterfowl and upland game birds and good habitat for rangeland and openland wildlife.

Because of flooding and wetness, this soil has poor suitability for campsites and it is moderately limited for use as picnic grounds.

Soil wetness caused by the water table and the hazard of flooding are obstacles to construction. Local roads need to be graded to shed rainwater. Because this soil has high shrink-swell potential, a more suitable base material than this Colo soil may be needed.

This soil is in capability units IIw-4 dryland and IIw-3 irrigated. It is in Subirrigated range site and windbreak suitability group 2.

Cp—Colo-Nodaway silty clay loams, 0 to 2 percent slopes. These nearly level, poorly drained and moderately well drained soils are on bottom lands along drainageways of uplands. Drains that cross these soils are generally less than 2 feet deep. Flooding is frequent. Areas are long and narrow and range from 5 to 150 acres.

This map unit is 35 to 60 percent Colo soils and 30 to 35 percent Nodaway soils. Nodaway soils are mostly adjacent to the drainageways. Areas of these soils are so intricately mixed that it is not practical to separate them in mapping.

Typically, the upper 36 inches of the Colo soil is very dark grayish brown, friable silty clay loam that has dark grayish brown fine strata. The next layer is very dark gray silty clay loam about 16 inches thick. It has common strong brown mottles and a few fine strata of light brownish gray material. The lower part, to a depth of 60 inches, is black silty clay loam that has a few brown mottles. In a few areas stratified silt loam or silty clay loam that is 10 to 20 inches thick overlies a buried soil.

Typically, the Nodaway soil has a surface layer about 8 inches thick. It is mixed very dark brown and dark grayish brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is very dark brown light silty clay loam that has strata of dark grayish brown material and a few fine brown mottles. In some areas the surface layer is silt loam.

Included with these soils in mapping are areas of Kennebec soils and Judson soils. These soils are on the highest parts of the map unit and are less frequently flooded than Colo-Nodaway soils. They make up 10 to 20 percent of the map unit.

Permeability is moderately slow in the Colo soils and moderate in the Nodaway soils. Runoff is slow. Both soils have high available water capacity, a moderate content of organic matter, and high natural fertility. The seasonal high water table is 2 or 3 feet below the surface in the Colo soil and 3 to 5 feet below the surface in the Nodaway soil. Both soils release moisture readily to plants. Shrink-swell potential is moderate in the Nodaway soils and high in the Colo soil.

Most of the acreage of these Colo-Nodaway soils is used for cultivated crops. Grass, trees, and shrubs grow in some areas. The potential is fair for trees and cultivated crops, good for grasses and wildlife habitat, and poor for most engineering uses because of wetness and flooding.

These soils are fairly well suited to corn and grain sorghum. Small grain and alfalfa are likely to be damaged by flooding. Wetness in the spring often delays tillage. Field terraces on slopes above these soils reduce the hazards of flooding and silting from eroding upland soils. If outlets are available, tile drains can be used to lower the water table. In some places, these soils are used as grassed waterways to carry away runoff from the sloping upland soils. The soils are suited to both gravity and sprinkler irrigation. Applications of water should be applied at a rate that does not exceed the intake rate of the soils.

This soil is well suited to reed canarygrass, an introduced cool-season species for tame pasture. Nitrogen fertilizer is likely to be needed for highest production. Weeds and brush can be controlled by use of chemicals. Mowing is not desirable.

Native grass provides a dependable source of forage on these soils, but many areas have been overgrazed and are invaded with weeds. Reseeding rangeland in poor condition quickly restores the more productive grass. A planned grazing system is needed to keep rangeland and tame pastures in good condition.

Few trees are planted for windbreaks on these soils. Windbreaks are generally used to protect homesites or livestock. Chances of tree survival and growth are good if trees are selected that can tolerate occasional wetness. Establishment of seedlings is commonly a concern during wet years.

Shrubs and trees that grow naturally provide cover and food for many kinds of wildlife. In some places, good sites are available for dams. Springs are a dependable source of water in many places. Some ponds are stocked with fish.

These soils are not suitable for homesites because of flooding and wetness. In urban areas, these soils are generally used as parks or open space. They have potential for gardens or planned wildlife areas. Roads that cross these areas need to be elevated with fill to prevent damage from flooding.

These soils are in capability units IIIw-4 dryland and IVw-3 irrigated. Colo soil is in Subirrigated range site and Nodaway soil is in Silty Overflow range site. The windbreak suitability group is 2.

Cr—Crete silt loam, terrace, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on loess covered stream terraces. Areas are irregular in shape and range from 5 to 500 acres.

Typically, the surface layer is about 13 inches thick. The upper part is very dark brown, friable silt loam, and the lower part is black, friable silty clay loam. The subsoil is about 27 inches thick. The upper part is very dark grayish brown, very firm silty clay; the middle part is brown, very firm silty clay; and the lower part is brown, firm silty clay loam. The underlying material, to a depth of 60 inches, is pale brown. The upper part is silty clay loam that has a few small lime concretions, and the lower part is silt loam with reddish brown mottles. In places, the surface layer is silty clay loam. On stream terraces of smaller tributaries, the subsoil is dark grayish brown or olive brown. In places, the underlying material is slightly affected with salinity or alkali. Stratified alluvial material is between a depth of 10 and 20 feet.

Included with this soil in mapping are small areas of Butler soils. The somewhat poorly drained Butler soils are in slightly depressional areas. They make up 5 to 10 percent of the map unit in many areas.

This Crete soil has slow permeability. Runoff is slow. Available water capacity is high, and content of organic matter is moderate. Natural fertility is high. The content of available phosphorus is medium or high in the surface layer, underlying material, and lower part of the subsoil. It is very low or low in that part of the subsoil where the content of clay is highest. Reaction of the surface layer is medium acid or slightly acid. Tilth is generally good, and the soil is easily tilled through a fairly wide range of moisture content. The fine textured subsoil restricts the penetration of roots, and it absorbs moisture slowly and releases it slowly to plants. Ground water is 6 to 12 feet below the surface. Shrink-swell potential of the subsoil is high.

Nearly all of the acreage of this soil is used for cultivated crops. This soil has good potential for most commonly grown cultivated crops, grasses, and trees. It has good potential for wildlife habitat and recreation uses and poor potential for most engineering uses.

This soil is suited to wheat, grain sorghum, soybeans, and alfalfa. Wheat is the most reliable crop, because it matures before the weather becomes hot and dry. Established stands of alfalfa can obtain moisture from ground water. Droughtiness is the main concern of management during dry years. Soil blowing is a hazard if the surface is bare. Corn, grain sorghum, and alfalfa respond well to irrigation. This soil is suited to sprinkler, furrow, and border irrigation. Land leveling commonly is needed to prepare the soil for irrigation unless sprinkler irrigation is used. If the subsoil is exposed during leveling, backfilling with topsoil improves the tilth and fertility of the surface layer. Applications of water should be adjusted at a rate that does not exceed the intake rate of the soil.

Very little acreage of this soil is used for pasture or range; however, the soil is well suited to both tame grass and native grass. Ground water increases production of some native grasses. Production of tame grasses can be significantly increased if the soil is irrigated. A cool-season grass pasture and a warm-season native grass range are often desirable. Undesirable plants invade pasture that is overgrazed.

This soil provides good sites for planted trees, and growth of adapted species is good. Drought and competition from weeds and grasses are the principal limitations. Mature trees often obtain moisture from ground water.

This soil has good potential for production of food for wildlife. Pheasants are common, but many other kinds of wildlife are scarce because the soil is intensively farmed. If additional trees or shrubs are established, the habitat for quail, squirrels, deer, and rabbits is improved.

This soil has moderate limitations for picnic areas and playgrounds because the surface layer dries slowly after rainfall. Surface drainage can be improved by land shaping.

Foundations and basement walls should be designed to withstand the shrinking and swelling of this soil. Reinforced concrete used in construction strengthens the walls of buildings. In some areas, water perched on underlying geologic material seeps into basements. Artificial drainage, footing drains, and basement sump pumps reduce seepage during wet periods. This soil is poorly suited to septic tank absorption fields because of slow permeability. It is well suited to sewage lagoons; however, if cuts are more than 2 feet deep, sealing or lining can be needed. This soil provides good areas for lawns if the clayey subsoil from excavated basements has not been spread over the surface. This excavated material is difficult to work and absorbs moisture slowly. Ground water and cave-ins are hazards in deep excavations. Moderate corrosivity to uncoated steel pipes occurs in places because of ground water and soluble salts. Coat-

ing of buried pipes is needed. Roads should be designed to offset the high shrink-swell potential of this soil.

This soil is in capability units IIs-2 dryland and IIs-2 irrigated. It is in Clayey range site and windbreak suitability group 4.

CrB—Crete silty clay loam, terrace, 1 to 3 percent slopes. This deep, very gently sloping, moderately well drained soil is on loess covered stream terraces. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 11 inches thick. The subsoil is about 37 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is brown, firm silty clay; and the lower part is light yellowish brown silty clay loam that has yellowish brown mottles and a few small lime concretions. The underlying material, to a depth of 60 inches, is light yellowish brown, noncalcareous silty clay loam that has yellowish brown mottles. In a few places the surface layer is silt loam. Although the soil is generally dark between a depth of 20 and 30 inches, it is light colored at a shallower depth in some areas. Stratified alluvial material is between a depth of 10 and 20 feet.

Included with this soil in mapping are small areas of Butler soils. The somewhat poorly drained Butler soils are on the lowest part of the map unit. These areas make up 5 to 10 percent of any mapped area. Small saline-alkali areas are also included.

This Crete soil has slow permeability. Runoff is medium. Available water capacity is high, and content of organic matter is moderate. Natural fertility is high. The content of available phosphorus is medium or high in the surface layer, underlying material, and lower part of the subsoil. It is low in the subsoil where the content of clay is highest. Reaction of the surface layer is medium acid or slightly acid. This soil is easy to work. The subsoil absorbs moisture slowly and releases it slowly to plants. Ground water is 6 to 12 feet below the surface. Shrink-swell potential of the subsoil is high.

Most of the acreage of this soil is used for cultivated crops. The rest is used for farmsteads and building sites. This soil has good potential for cultivated crops, grasses, and trees. It has good potential for wildlife habitat and recreation uses, and poor potential for most engineering uses.

This soil is suited to wheat, grain sorghum, soybeans, and alfalfa. Alfalfa production is increased by moisture from ground water in most places. Controlling runoff, reducing the hazard of erosion, and increasing soil moisture are the principal management needs. Contour farming and terraces reduce runoff, control erosion, and help to hold water until it can be absorbed by the soil. A tillage system that leaves a maximum amount of crop residue on the surface helps to prevent loss of moisture, especially in fall and winter. Grain sorghum, corn, and alfalfa produce the highest yields if this soil is irrigated. If gravity systems are used, some land leveling is needed for proper distribution of water. If the subsoil is exposed during leveling, undercutting and backfilling with 6 inches of topsoil is desirable. The rate of application of water should not exceed the intake rate of the soil. Runoff from rainfall and irrigation water can be controlled by terracing, contouring, bench leveling, and adjusting the row direction to provide for a lower grade of furrow.

This soil is well suited to cool-season grasses, for example, bromegrass and tall fescue. It responds well to applications of fertilizer. Forage production is increased if the soil is irrigated, and if grass and legume mixtures are used. Season-long forage can be produced if cool-season pasture and temporary sudangrass pasture are combined. For a more stable forage production program, the addition of native warm-season grasses to this combination is desirable. Deep rooted grasses benefit from ground water.

This soil provides good sites for windbreaks. Chances are good for the survival of plantings and growth of adapted species. Drought and moisture competition from weeds and grasses are the main hazards. Cultivation or applications of chemicals can be used to kill weeds. Mature trees can obtain moisture from ground water. If properly designed and placed, windbreaks can control drifting of snow, supply protection for homes and livestock, and reduce noise from traffic.

Cultivated crops and grassed fence rows provide good habitat for pheasants. If areas are properly selected and vegetation is distributed, habitat for wildlife can be improved.

Camp sites, picnic areas, and playgrounds have moderate limitations because the surface layer of this soil dries slowly after rainfall. Land shaping improves the surface drainage.

This soil has limitations for buildings because of shrink-swell; however, proper construction can prevent damage. It is poorly suited to septic tank absorption fields because of slow permeability; however, it affords good sites for sewage lagoons. The friable surface layer of this soil should be stockpiled and respread over the lawn area after grading. The clayey subsoil should not be exposed because it is difficult to work and it absorbs moisture slowly. In some areas, water may be perched on underlying geologic material and seepage into basements can occur during wet periods. Artificial drainage, footing drains, and basement sump pumps can help to reduce wetness. Ground water and cave-ins are hazards in deep excavations. High or very high corrosivity to uncoated pipes occurs in places because of ground water and soluble salts. Coating of buried pipes is needed.

This soil is in capability units IIe-2 dryland and IIe-1 irrigated. It is in Clayey range site and windbreak suitability group 4

CrC—Crete silty clay loam, terrace, 3 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on stream terraces. Areas are generally irregular in shape and range from 10 to 80 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is brown, firm silty clay; and the lower part is brown, friable silty clay loam that has common medium lime concretions. The underlying material, to a depth of 60 inches, is brown silty clay loam. Some areas have less clay in the subsoil than is typical. Stratified alluvial material is between a depth of 10 and 20 feet.

Included with this soil in mapping are small saline-alkali areas. They make up less than 5 percent of the map unit.

This Crete soil has slow permeability and high available water capacity. Runoff is medium. Content of organic matter is moderate, and natural fertility is high. Content of available phosphorus is generally low or medium. The underlying material is saline or alkali in places. Moisture is absorbed and released slowly to plants. The clayey subsoil somewhat restricts the growth of roots. The soil is generally easy to work. Ground water is commonly 6 to 12 feet below the surface. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated. The soil has good potential for cultivated crops, grasses, and trees. The potential is fair for openland wildlife habitat and poor for most engineering uses.

This soil is best suited to grain sorghum and wheat. Corn, soybeans, and alfalfa are also grown. In most places, alfalfa production is increased by moisture from ground water. Water erosion is the principal hazard if this soil is cultivated. Conservation of moisture is a primary concern of management. A cropping system that includes good tillage management and that alternates row crops with small grain and legumes helps to increase the moisture intake rate of this soil. Contour farming and terraces help to reduce runoff and control erosion.

Non-legume crops commonly respond to nitrogen and phosphorus. In some areas, the content of available phosphorus is sufficient for good plant growth. Irrigated areas of this soil are generally adjacent to less sloping soils. Land leveling and contour bench leveling are needed to help control erosion and to conserve water. If furrows or borders are used, irrigation systems need to be designed so that slope of the crop rows is not more than 1 percent. Sprinkler irrigation may be more practical on irregular slopes than other systems of irrigation. The application of water should not exceed the intake rate of the soil.

Tame grass pastures need to be fertilized for good forage production. If pasture production declines, the old stand can be plowed under and desirable grasses reestablished. Bromegrass is the most common grass, and alfalfa is often included in the seed mixture for better forage production. This bromegrass-alfalfa pasture fits well into the cropping system of irrigated fields. Alfalfa and deep rooted grasses benefit from ground water. The roots of legumes help to increase the moisture intake and permeability of the soil.

Few areas of this soil are in native grass. However, these warm-season native grasses in combination with cool-season tame grass pasture can provide season-long grazing.

Good sites for windbreaks are available on this soil. Although trees cannot be established easily in every year, healthy seedlings of adapted species survive and grow well if they are properly planted in well prepared soil and carefully tended after planting. Mature trees can obtain moisture from ground water. Tree windbreaks around homesites slow windspeed, help settle dust, and reduce noise.

The most common wildlife game are pheasants and mourning doves. The large amount of grain produced on this soil provides an abundance of food. Trees and shrubs planted around homesites and farmsteads also provide food and cover for many birds and mammals.

Buildings need to be designed to withstand the shrinking and swelling of this soil. Seepage into basements is a problem in some places where water is perched on underlying geologic materials. Artificial drainage, footing drains, and basement sump pumps can reduce or overcome seepage. This soil is poorly suited to septic tank absorption fields because of slow permeability. It is not suitable for sewage lagoons unless the slope is modified. Ground water and cave-ins are hazards in deep excavations. High or very high corrosivity to uncoated steel pipes occurs in places because of ground water and soluble salts. Coating of buried pipes is needed. This soil is well suited to lawns and gardens if the surface layer is not covered with fill or if it was not removed in land shaping for a building site.

This soil is in capability units IIIe-2 dryland and IIIe-1 irrigated. It is in Clayey range site and windbreak suitability group 4.

CsB—Crete Variant silty clay loam, 1 to 4 percent slopes. This deep, very gently sloping, moderately well drained, saline-alkali soil is on stream terraces and lower side slopes of uplands. The vegetation has a patchy appearance. Growth is fair on the less affected areas, but it is very stunted on the more severely affected areas. Areas are irregular in shape and range from 3 to 80 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 19 inches thick. The upper part is very dark gray, firm silty clay; the middle part is dark grayish brown, firm silty clay; and the lower part is grayish brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is brown silty clay loam. The underlying material and lower part of the subsoil have small lime concretions.

Included with this soil in mapping are small areas not affected with soluble salts. These slightly higher areas make up 5 to 20 percent of the unit.

This Crete Variant soil has slow permeability and moderate available water capacity. Content of organic matter

is moderate, and runoff is slow. This soil ranges from being slightly affected to moderately affected with soluble salts. Even on the more productive parts of the soil exchangeable sodium retards plant growth. Reaction of the surface layer ranges from medium acid to neutral. Reaction in the subsoil and underlying material ranges from strongly alkaline in the areas more severely affected with soluble salts to neutral in the less affected areas. The content of available phosphorus below the plow layer is generally low or medium. The scabby, moderately saline-alkali areas are low in natural fertility. They are difficult to till because the soil is hard when dry and sticky when wet.

Most of the acreage of this soil is used for cultivated crops. A few areas are in tame pasture or native grass. This soil has fair potential for cultivated crops, grass, and wildlife habitat. The potential is poor for tree windbreaks and for most engineering uses.

This soil is poorly suited to grain sorghum, alfalfa, and small grain. Reducing alkalinity and salinity and water erosion are the main concerns of management. If suitable outlets are available, surface drainage can be improved by land shaping. Applications of gypsum or sulfur may be needed to counteract the alkali condition. Because these amendments are expensive, soil tests should be made to determine the amount needed. Large additions of organic matter help to diminish the effect of alkali salt on crops. The content of organic matter and plant nutrients can be increased by applications of manure and fertilizer, and by the use of legumes in the cropping system. Leaving a cover of crop residue on this soil helps prevent crusting after rain. Such a cover also helps to control water erosion and reduces droughtiness caused by the clayey subsoil and soluble salts. Cutting for silage removes residue needed to reclaim the soil.

This soil is suited to tall wheatgrass for tame grass pasture. Irrigation can more than double forage production.

Few areas are in native grass because this soil is generally used for cropland. However, native grassland can provide forage during the summer months and protect the soil from water erosion. Cool-season pasture in combination with warm-season range can provide season-long grazing.

This soil is poorly suited to tree plantings. Chances of survival and growth of adapted species are fair to poor. The saline-alkali condition of the soil is the principal limitation. Planting tolerant tree species that are adapted to this soil tends to minimize this limitation.

Grain sorghum and wheat provide food for pheasants. Wheatfields provide nesting areas that are generally undisturbed until after the peak of the pheasant hatch.

The saline-alkali areas are poor sites for lawns, trees, shrubs, and gardens. Alkali salts are toxic to plants, and the soil is droughty. Affected areas are difficult to work. Land shaping can expose additional alkali affected areas.

This soil is poorly suited to septic tank absorption fields because of slow permeability. Because of moderate permeability below a depth of 3 feet, seepage from sewage lagoons is a hazard unless the floor of the lagoon is sealed. Buildings need to be designed to withstand the high shrinking and swelling of the soil. Seepage into basements is a hazard. Artificial drainage, footing drains, and basement sump pumps help to reduce or overcome soil wetness. Coating of buried pipes is needed because of the salts in the soil. Roadbanks are difficult to vegetate. Grasses that are tolerant of alkali salts should be planted.

This soil is in capability units IVs-1 dryland and IVs-1 irrigated. It is in Saline Lowland range site and windbreak suitability group 8.

Ct—Crete silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on broad divides of the loess uplands. Areas are typically 50 to 500 acres.

Typically, the surface layer is black and about 13 inches thick. It is friable silt loam in the upper part and friable silty clay loam in the lower part. The subsoil is about 26 inches thick. The upper part is very dark grayish brown, firm silty clay; the next layer is dark brown, very firm silty clay; the next layer is dark grayish brown, very firm, silty clay; and the lower part is dark grayish brown, firm silty clay loam that has strong brown mottles and common small lime concretions. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam that has small lime concretions and small accumulations of carbonates. Brown and yellowish red mottles are also present. Small areas of this soil on narrow ridges have a surface layer of silty clay loam.

Included with this soil in mapping are small areas of Butler soils. These somewhat poorly drained Butler soils are in slight depressional areas and in areas at the heads of drainageways. They make up 5 to 15 percent of each mapped area.

This Crete soil has slow permeability and high available water capacity. Runoff is slow. Content of organic matter is moderate, and natural fertility is high. Below the plow layer, to a depth of 5 feet, the content of available phosphorus is low or very low. Reaction of the surface layer is medium acid or slightly acid. Moisture is absorbed slowly by the subsoil and released slowly from the subsoil. Shrink-swell potential of the subsoil is high.

Most of the acreage of this soil is used for cultivated crops. Farmsteads and villages are in a few places. This soil has good potential for wildlife habitat and recreation uses and poor potential for most engineering uses. The potential is good for cultivated crops, grass, and trees.

This soil is suited to grain sorghum, wheat, and alfalfa. It is suited to corn if irrigated. Applications of phosphorus and lime are needed. Additional nitrogen is needed for crops other than legumes. Movement of air and water through the subsoil is slow, and penetration by roots is restricted. Because the claypan limits effective water storage, crops tend to burn in dry weather. Grasses and legumes in the cropping system help to keep the subsoil

from compacting and make water penetration easier. Stubble mulching helps to improve tilth and reduces evaporation. This soil is suited to border, furrow, or sprinkler irrigation. If a gravity irrigation system is used, some land leveling generally is needed to manage the irrigation water efficiently. Care needs to be taken so that the very firm subsoil is not exposed. This layer is difficult to plow or cultivate and crops do not respond well if the subsoil is at the surface. Controlling the rate of water application helps to conserve irrigation water. Water collected in an irrigation water reuse pit can be recycled to irrigate the same field or other fields.

This soil is well suited to cool-season pasture and to native grass rangeland; however, few areas are in permanent grass. Bromegrass and tall fescue are cool-season grasses that grow well on this soil. Applications of fertilizer and use of irrigation increase forage production. A stable forage production program can be obtained by combining native warm-season grass range with cool-season pasture. This soil is suited to the production of bluegrass sod if irrigation water is available.

Trees planted in windbreaks survive well and grow fairly well on this soil. Drought and moisture competition from weeds and grasses are the principal hazards. The soil can be cultivated or chemicals can be used to kill weeds. Properly designed and placed windbreaks control drifting of snow, provide protection for homesites and livestock, and improve habitat for wildlife. In addition, trees improve sites for playgrounds and other areas used for recreation.

This soil provides good habitat for openland wildlife. Pheasants are common. Trees planted on homesites furnish habitat for birds that help control insects.

This soil is not suited to septic tank absorption fields because of slow permeability. It is suited to sewage lagoons that are used for building sites. Foundations and basement walls need to be designed to withstand the shrinking and swelling of this soil. This soil becomes saturated during periods of heavy rainfall, and seepage into basements can be a problem. Footing drains and basement sump pumps can help to reduce or overcome seepage. Because natural drainage outlets are seldom available, landscaping should be designed to drain surface water away from buildings. The friable surface layer should be stockpiled and respread over the lawn area after grading. The clayey subsoil should not be exposed because it is droughty and low in available plant nutrients. The nearly level topography and open spaces on this soil provide good sites for airfields. Roads need to be paved or elevated and gravelled.

This soil is in capability units IIs-2 dryland and IIs-2 irrigated. It is in Clayey range site and windbreak suitability group 4.

DcD—Dickinson fine sandy loam, 6 to 11 percent slopes. This strongly sloping, somewhat excessively drained soil is on side slopes and narrow ridgetops on uplands. Areas are irregular in shape and range from 3 to 75 acres.

Typically, the surface layer is very friable fine sandy loam about 12 inches thick. It is very dark brown in the upper part and very dark grayish brown in the lower part. The subsoil is very friable fine sandy loam about 18 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The underlying material, to a depth of 60 inches, is yellowish brown loamy fine sand (fig. 6). In some places, the underlying material is light brownish gray with thin yellowish brown iron bands. In a few areas where the soil is eroded, the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Morrill soils that are finer textured and are generally at a higher elevation than Dickinson soil. A few areas of mod-

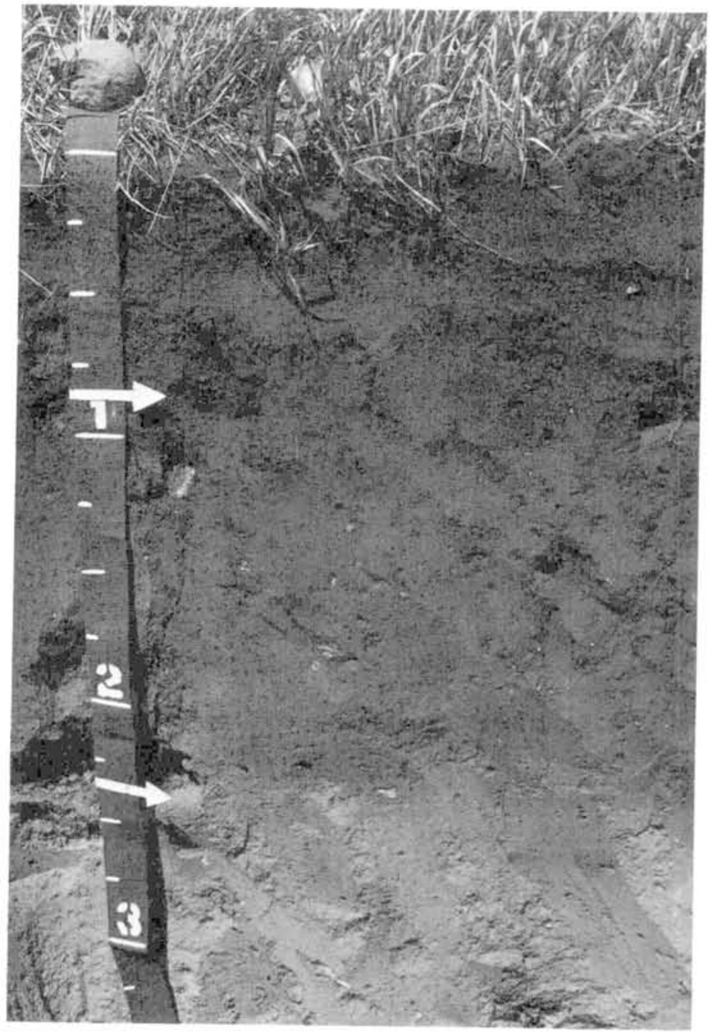


Figure 6.—Profile of Dickinson fine sandy loam, 6 to 11 percent slopes. This moderately coarse soil formed in glacial outwash that was reworked by wind and water.

erately steep Dickinson soils are also included. These soils make up 5 to 15 percent of the map unit.

This Dickinson soil has moderately rapid permeability and medium runoff. Available water capacity is moderate, and content of organic matter is moderately low. Natural fertility is medium. Because tilth is generally good, the soil is easily tilled through a fairly wide range of moisture content. Moisture is released readily to plants. Reaction of the surface layer is slightly acid or medium acid. Shrink-swell potential is low.

Most of the acreage of this soil is in native grass and is used for grazing; however, some areas are cultivated. This soil has poor potential for cultivated crops, grasses, wildlife habitat, and for most engineering uses. The potential is good for trees.

This soil is suited to small grain, alfalfa, and tame grasses. Row crops grow well if they are limited in the cropping system, and if erosion is controlled. Soil blowing and water erosion are the main hazards, but loss of fertility and droughtiness are also concerns of management. Where feasible, terraces, waterways, and contour farming can be used to protect the soils. Stubble mulching and wind stripcropping help to prevent soil blowing. Frequent use of cover crops in the cropping sequence is desirable. Returning crop residue to the soil and applying nitrogen fertilizer help to maintain fertility. Applying barnyard manure, especially to eroded areas, improves the fertility and adds to the content of organic matter. In places, liming is needed before alfalfa is planted. Burning of crop residue is not desirable.

This soil is suited to sprinkler irrigation. Other irrigation methods are difficult to manage and require a great deal of land preparation. Loss of irrigation water by runoff is a common problem, but it generally is not excessive if the water is applied at the proper rate.

Bromegrass, orchardgrass, and tall fescue are introduced species that grow well on this soil. These grasses begin to grow early in spring and reach peak growth in May or June. The addition of a warm-season native grass range that attains peak growth during July and August is desirable. In combination with other grasses, these grasses provide forage during the entire growing season. Tame grasses respond to applications of fertilizer, but soil tests and estimates of the amount of available soil moisture should be used as guides to determine the amount and kinds of fertilizer to apply.

If grazing is increased, such grasses as little bluestem, needleandthread, prairie sandreed, and sand dropseed increase in percentage of plant population. Overgrazed areas are invaded with blue verbena, western ragweed, and Scribner panicum. Range management should include proper grazing use, deferred grazing, and a planned grazing system. Poor distribution of livestock on this soil can destroy vegetation and cause blowouts. Water and salting facilities within the pasture should be placed on soils other than Dickinson soils. If proper grazing management practices are observed, this soil should provide good habitat for wildlife.

Shrubs provide habitat for wildlife and are commonly included in tree windbreaks. Adapted trees have a fair chance for survival and growth if they are not subjected to soil blowing and inadequate moisture. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Because they can be damaged by livestock, tree windbreaks should be protected by fences if they are planted in feedlots or pastures.

This soil is well suited to septic tank absorption fields; however, these fields should be installed on the least sloping part of the soil. Limitations are slight or moderate for dwellings with basements; however, in some places, sandstone below a depth of 5 feet causes a perched water table. Because this soil has sandy underlying material that is low in fertility, topsoil should be stockpiled and respread over the building site after construction. Potential is poor for dams because of high seepage. This soil is a fair source for fine sand below a depth of 3 feet.

This soil is in capability units IVe-3 dryland and IVe-8 irrigated. It is in Sandy range site and windbreak suitability group 3.

DcD2—Dickinson fine sandy loam, 6 to 11 percent slopes, eroded. This strongly sloping, somewhat excessively drained soil is on side slopes and narrow ridgetops. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is brown, very friable fine sandy loam 10 inches thick. The subsoil is dark yellowish brown and about 18 inches thick. The upper part is very friable fine sandy loam and the lower part is very friable loamy fine sand. The underlying material is brown loamy fine sand. In places, wind erosion has removed the fine material, and the surface layer is loamy fine sand. In places, the surface layer is dark brown and very dark grayish brown.

Included with this soil in mapping are small areas of Morrill soils and Steinauer soils. These soils are finer textured than Dickinson soils and are generally at a higher elevation. They make up 5 to 15 percent of the map unit.

This Dickinson soil has moderately rapid permeability and medium runoff. Available water capacity is moderate, and content of organic matter is low. Natural fertility is low. This soil is naturally deficient in content of phosphorus and nitrogen. It is easy to till and absorbs moisture easily and releases it readily to plants. The surface layer is medium acid or slightly acid. Shrink-swell potential is low.

Most of the acreage of this soil has been cultivated; however, many areas have been reseeded to permanent grass. The soil has fair potential for grass, wildlife habitat, and for most engineering uses. It is poorly suited to grain sorghum and winter wheat. Potential is good for tree windbreaks.

In places the cultivated areas of this soil are fewer than 10 acres, but they are adjacent to soils that are

better suited to cultivation. This soil is highly susceptible to soil blowing. Because of slope, water erosion is a moderate hazard. Applications of barnyard manure help to maintain and improve the content of organic matter.

This soil is suited to sprinkler irrigation. Other irrigation methods are difficult to manage and require a large amount of land preparation. Because runoff is a problem on this soil, the rate of application of irrigation water should not exceed the intake rate of the soil. Crop residue should be returned to the soil.

This soil is best suited to native grass which provides permanent cover and prevents soil blowing and water erosion. Proper grazing use and deferred grazing help to maintain and improve stands of grass. More nearly uniform grazing can be obtained by proper placement of fences, salt, and water.

This soil is suited to tree planting if strips of sod or other plant cover are maintained between the rows to control soil blowing. Cultivation should be restricted to the tree rows. Drought and moisture competition from grasses and weeds are hazards.

Some areas in cultivated fields can be reseeded for the development of wildlife habitat. Undisturbed areas provide food and cover for wildlife.

This soil provides fair building sites. Lawn areas are low in fertility and tend to be droughty in places. Topdressing the surface with dark, friable soil material helps to improve these areas. Because of slope, some land shaping is commonly needed. The soil is well suited to septic tank absorption fields if these fields are installed on the least sloping parts of the soil. Potential is poor for dams because of high seepage. This soil is a source for fine sand below a depth of 3 feet.

Roadcuts should be seeded to adapted grass and the gradient kept to a minimum. Mulching with straw or hay helps to prevent soil blowing until the grass is established.

This soil is in capability units IVe-3 dryland and IVe-8 irrigated. It is in Sandy range site and windbreak suitability group 3.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained soil is in shallow depressional areas or in basins of the loess uplands or stream terraces. It is occasionally flooded by runoff from adjacent uplands. Areas are irregular in shape and range from 3 to 30 acres.

Typically, the surface layer is friable silt loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark gray. The subsurface layer is gray, very friable silt loam about 4 inches thick. The subsoil is very firm silty clay about 32 inches thick. The upper part is black, and the lower part is dark grayish brown. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam that has yellowish brown mottles. It has lime and iron concretions.

Included with this soil in mapping are small areas of Butler soils and Crete soils that are better drained than Fillmore soil. They are on the higher parts of the landscape. These soils make up 5 to 10 percent of the map unit.

This Fillmore soil has very slow permeability and very slow runoff. The perched seasonal high water table can be as much as 6 inches above the surface to 12 inches below the surface. Available water capacity is high, and content of organic matter is moderate. Natural fertility is medium. Reaction of the surface layer is medium acid or slightly acid. The subsoil absorbs water slowly and releases it to plants slowly. Penetration by roots is difficult. The surface layer is friable and easy to till when dry. Shrink-swell potential of the subsoil is high.

Most of the acreage of this soil is used for cultivated crops because it is adjacent to larger areas of better drained soils. The potential is fair for cultivated crops, range, and pasture and good for wildlife habitat. The soil has poor potential for tree windbreaks and for most engineering uses because of wetness, very slow permeability, and the shrink-swell characteristic.

Dryfarmed areas of this soil are suited to grain sorghum and small grain, but these areas are poorly suited to corn. The soil is poorly suited to alfalfa because of wetness. This soil is occasionally ponded after heavy rainfall. Spring planting is likely to be delayed, and growing crops can be damaged. If outlets are available, the excess water can be removed by open ditches. Surface drainage is needed before the soil is irrigated. Land leveling to provide a surface gradient may be needed for gravity irrigation. Irrigated areas of this soil are well suited to grain sorghum. Liming is needed to reduce the acidity of the surface layer. Sprinkler, border, and furrow systems of irrigation can be used.

Bromegrass, tall fescue, and reed canarygrass are most commonly grown in tame pasture. The kind of native grass is determined mainly by the excess water and slow permeability of the soil. If this soil is grazed when wet, surface compaction and small mounds tend to develop.

This soil is suited to windbreak plantings if the trees selected can tolerate occasional wetness and droughtiness. Establishing trees and cultivating between the rows can be difficult in wet years. The abundant and persistent herbaceous vegetation that grows in the tree rows is a management concern because it competes with the trees.

Corn and grain sorghum supply food for pheasants, and wheatfields commonly supply food and nesting areas. Ponding of soils during wet seasons provides shallow water areas that are used as habitat by waterfowl and other wildlife.

This soil is poorly suited to homesites and other building sites, septic tank absorption fields, and sewage lagoons because of ponding and wetness. Flooding, wetness, very slow permeability, and very high shrinking and swelling are limitations.

This soil is in capability units IIIw-2 dryland and IIIw-2 irrigated. It is in Clayey Overflow range site and windbreak suitability group 2.

GeD—Geary silty clay loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on side slopes and narrow ridges of uplands (fig. 7). Areas are irregular in shape and range from 5 to 25 acres.

Typically, the surface layer is friable silty clay loam about 12 inches thick. It is very dark brown in the upper part and dark brown in the lower part. The subsoil is about 30 inches thick. The upper part is dark brown, firm silty clay loam and the lower part is dark brown, firm clay loam. The underlying material, to a depth of 60 inches, is firm, dark brown clay loam.

Included with this soil in mapping are small areas of Mayberry soils and Sharpsburg soils that are finer textured than Geary soil. Mayberry soils are on lower side slopes, and Sharpsburg soils are on upper side slopes and are higher lying than the Geary soils. The included soils make up 10 to 20 percent of this map unit.

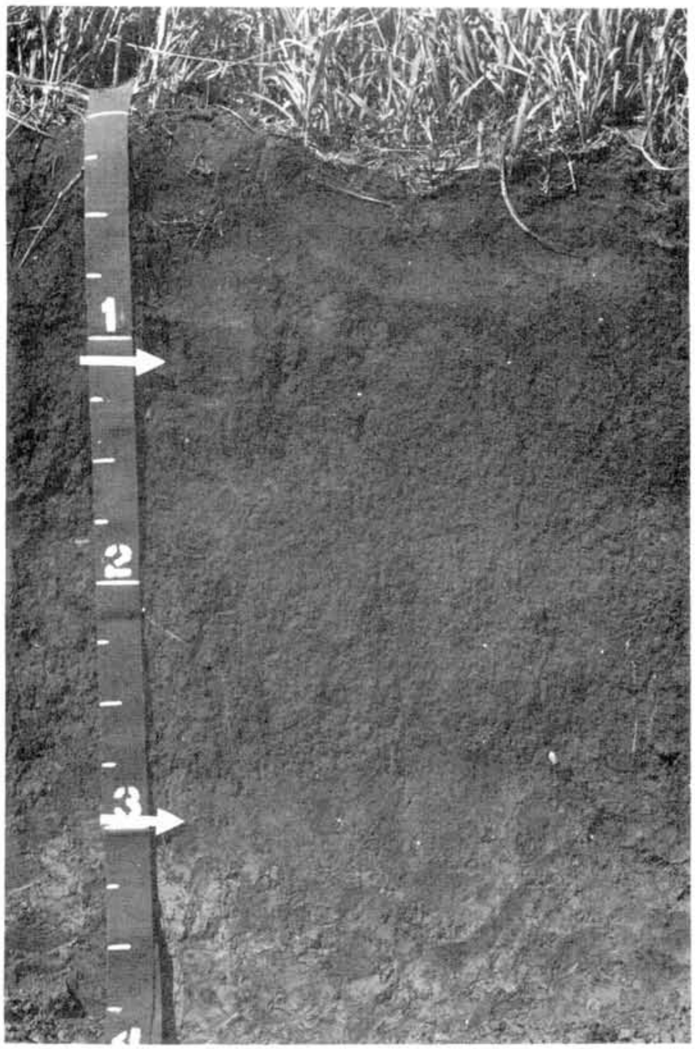


Figure 7.—Profile of Geary silty clay loam, 6 to 11 percent slopes. The subsoil is between a depth of 12 and 37 inches.

Permeability is moderately slow in this Geary soil, and available water capacity is high. Content of organic matter is moderate, and natural fertility is medium. Runoff is medium or rapid depending upon the kind and amount of vegetation. Reaction is medium acid in the surface layer and slightly acid in the subsoil. Shrink-swell potential is moderate.

Most of the acreage of this soil is used for cultivated crops. A few areas are in native grass. This soil has fair potential for cultivated crops and good potential for grasses and trees for windbreaks. It has good potential for wildlife habitat and fair potential for most engineering uses.

This soil is suited to corn, grain sorghum, wheat, soybeans, and alfalfa. Controlling water erosion is the main concern of management. Conserving moisture and maintaining good tilth, fertility, and content of organic matter are other concerns. Terraces, grassed waterways, contour farming, and use of crop residue as mulch help to control runoff and erosion. Soil fertility can be maintained and improved by applications of manure and commercial fertilizer. Application of lime neutralizes acidity of the soil and is especially needed on areas planted to legumes. Soil tests can determine the amounts of fertilizer and lime required. A cropping system that includes such close growing crops as small grain, alfalfa, and grasses is needed. Row crops should be limited in the cropping system. This soil is fairly well suited to sprinkler irrigation. Erosion is difficult to control during natural rainfall and irrigation because of slope. The rate of water application needs to be carefully controlled so that it does not exceed the intake rate of the soil.

Introduced cool-season grasses provide green vegetation for grazing in spring. Bromegrass is the most common species, but wheatgrass and tall fescue are also used. These grasses can be mixed with legumes, for example, alsike clover, birdsfoot trefoil, and lespedeza. Birdsfoot trefoil is tolerant of acid soils and is less likely to cause bloat in livestock than other legumes. Lespedeza and birdsfoot trefoil grow well during drought, but they are difficult to establish because of their low tolerance to weed competition. Use of legumes in the grass mixture supplies some of the nitrogen requirement of grasses, but applications of phosphate fertilizer are generally essential. Overgrazed areas are invaded by Kentucky bluegrass, blue verbena, and many annuals. Proper stocking helps keep the pasture in good condition. Although cool-season pasture grasses produce more forage for grazing, range seedings are less costly.

Deferred grazing is the practice most commonly used to improve or maintain the range condition. Allowing about half the current year's growth to be used provides ample grazing and permits the most desirable species to maintain themselves.

This soil is well suited to field, farmstead, and feedlot windbreaks. It is suited to all trees and shrubs that have moderate drought resistance. Erosion from wind and water and moisture competition from grasses and weeds are hazards during establishment of seedlings. If the subsoil has been exposed during excavation and construction, establishment of ornamental trees and shrubs is difficult.

This soil is generally not suited to septic tank absorption fields because of moderately slow permeability. It is not suited to sewage lagoons because of slope. The high susceptibility to frost action and erosion makes this soil unsuitable as fill material for earthen dams, dikes, and levees. Because water is often perched on the underlying material, artificial surface drainage, footing drains, and basement sump pumps may be needed to reduce or overcome seepage. Reinforcing subsurface structures can reduce the severe limitation from shrink-swell. Road and street subgrades need to be designed to reduce frost action potential.

This soil is in capability units IIIe-1 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

GeD2—Geary silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on side slopes and narrow ridgetops of uplands. It formed in reddish brown Loveland Loess. Areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is friable, dark brown silty clay loam about 7 inches thick. The subsoil is firm silty clay loam about 30 inches thick. It is dark yellowish brown in the upper part and dark brown in the lower part. The underlying material, to a depth of 60 inches, is friable, brown silty clay loam. In places the surface layer is thinner than is typical and contains more clay because of mixing of the surface soil and subsoil in plowing.

Included with this soil in mapping are small areas of finer textured Mayberry soils and Sharpsburg soils. Sharpsburg soils are at higher elevations on upper side slopes and ridgetops. These inclusions make up 10 to 20 percent of the map unit.

Permeability is moderately slow in this Geary soil, and available water capacity is high. Content of organic matter is moderately low, and natural fertility is medium. Runoff is rapid. Reaction is typically medium acid in the surface layer and slightly acid in the subsoil. The content of available phosphorus is generally low. Shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. A few areas have been reseeded in grass. The potential for cultivated crops is poor because of the moderately low content of organic matter, medium fertility, and the severe hazard of erosion. The potential is fair for wildlife habitat and good for tree windbreaks and grasses. This soil has fair potential for most engineering uses.

This soil is suited to grain sorghum, wheat, soybeans, and alfalfa. Erosion caused by rapid runoff and maintenance of the content of organic matter and fertility are main management concerns. Terraces, grassed waterways, contour farming, and use of crop residue as a mulch help control runoff and erosion. Liming neutralizes the acidity of the soil. A good crop rotation program, the application of manure, and using a green manure crop such as sweetclover in the cropping system increase the content of organic matter and fertility of the soil.

This soil is suited to sprinkler irrigation. To prevent runoff and water erosion, water should be applied at a rate that does not exceed the water intake rate of the soil. Crop residue should be returned to the soil.

Establishment of pasture grasses is highly desirable on this soil because it helps to control erosion and restores organic matter. In addition, the grasses can be grazed. Before reseeding, a soil test should be made to determine nutrient deficiency. Introduced cool-season grasses provide green vegetation for grazing in spring and fall. Bromegrass is most commonly used, but some wheatgrass and tall fescue are also grown. A grass-legume mixture can be used for sustained production. Birdsfoot trefoil, alsike clover, and lespedeza are legumes that grow well under droughty conditions. Birdsfoot trefoil reduces the danger of bloat in livestock and is a desirable addition to most pasture grasses in this map unit.

Warm-season grasses can be used for maximum grazing during summer and early in fall. Establishment of grasses can be difficult unless fertility is adequate and precaution is taken to eliminate competition from weeds and other invaders, for example, bindweed, blue verbena, and Kentucky bluegrass. Proper grazing use and planned grazing systems help to keep the range in good condition. Deferred grazing improves and maintains the range condition. If about half of the current year's growth is left on the soil, desirable species can be maintained.

Loss of topsoil due to erosion hinders the growth of tree seedlings in windbreaks. Cultivated areas should be summer fallowed so that moisture content can be increased before trees are planted. Competing weeds and grasses need to be controlled either chemically or through cultivation, until the trees are large enough to help control competitive vegetation by their shade. Trees and shrubs that have moderate drought resistance should be planted on this soil.

This soil is poorly suited to septic tank absorption fields because of moderately slow permeability, and it is poorly suited to sewage lagoons because of slope. Water is often perched on the underlying material. Artificial drainage, footing drains, and basement sump pumps can reduce or overcome wetness. Because of high susceptibility to frost action and erodibility, this soil is not suitable for use as subgrades for roads or fill material for earthen dams, dikes, and levees. Road and street subgrades need to be designed to reduce the frost action potential. Shrink-swell can be reduced by reinforcing subsurface structures.

This soil is in capability units IVe-8 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

HeF—Hedville sandy loam, 6 to 30 percent slopes. This shallow, strongly sloping to steep, somewhat excessively drained soil is on side slopes. It formed in material weathered from sandstone. Areas are irregular in shape and range from 3 to 15 acres.

Typically, the surface layer is about 11 inches thick. The upper part is very dark grayish brown, friable sandy loam; and the lower part is dark brown, friable, angular cobbly sandy loam. The underlying material, to a depth of 15 inches, is strong brown loamy sand. Below this depth is yellowish brown sandstone. The sandstone bedrock is typically 10 to 20 inches below the surface. In a few places, however, depth to sandstone ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of Dickinson soil and Morrill soils. These areas are generally at a higher elevation than Hedville soil, and the depth to sandstone is more than 40 inches. Outcrops of sandstone are also included. The included areas make up 5 to 20 percent of the map unit.

This Hedville soil has moderate permeability above the bedrock. Runoff is medium or rapid. Available water capacity is very low and content of organic matter is moderate. Natural fertility is low. The sandstone bedrock restricts root penetration and limits water movement. Shrink-swell potential is low.

Nearly all of the acreage of this soil is in native grass and is used for grazing. The soil has poor potential for cultivated crops and for most engineering uses. The potential is fair for wildlife habitat and pasture and very poor for tree windbreaks.

This soil is poorly suited to cultivated crops and tame grass pasture because of steep slopes and shallow depth to rock. Erosion can expose the bedrock.

The use of this soil for rangeland is very effective in controlling erosion. Blue grama and sand dropseed increase or become invaders if this soil is overgrazed. At least half of each year's growth should be left on the surface as mulch to help maintain an adequate cover. The use of chemicals helps to control weeds and brush.

This soil is poorly suited to windbreaks. However, trees and shrubs can be planted by hand in some areas for recreation purposes or for wildlife habitat. If the natural cover is protected, or if a needed cover is established, conditions for producing and maintaining wildlife can be improved.

Areas of this soil are small but contrasting in the landscape. Slope is a limitation where sites are developed for recreation. The uniqueness of the exposed sandstone adds to the interest of recreation areas. Shallow bedrock is a severe limitation for any construction that requires excavation. Buried pipes are difficult to install. Foundations can be built on this soil; however, sliding can occur at a point where the soil and bedrock contact. The bedrock has good bearing capacity for foundations. To establish lawns after construction, areas need to be topdressed with fertile soil.

This soil is in capability unit VIs-4. It is in Shallow Sandy range site and windbreak suitability group 10.

JfC—Judson fine sandy loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on colluvial foot slopes. Areas are long and narrow and range from 3 to 40 acres.

Typically, the surface layer is about 21 inches thick. The upper part is very dark brown, friable fine sandy loam, and the lower part is very dark grayish brown, friable loam. The subsoil is dark brown, friable loam about 9 inches thick. The underlying material, to a depth of 60 inches, is silty clay loam. The upper part is dark grayish brown and the lower part is grayish brown. The underlying material has yellowish brown mottles. In places where soil blowing has removed the fine textured material, the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of strongly sloping Dickinson soils and nearly level Kennebec soils. Dickinson soils are on the higher elevations. Kennebec soils are on occasionally flooded bottom lands. These soils make up 10 to 20 percent of the map unit in most areas.

Permeability is moderate in this Judson soil, and available water capacity is high. Runoff is medium. The content of organic matter is moderate; however, it is moderately low on wind eroded areas. Fertility is medium. The surface layer is medium acid. This soil absorbs moisture easily and releases it readily to plants. It is easy to till. Shrink-swell potential is low in the upper part and moderate in the underlying material.

Most of the acreage of this soil is used for cultivated crops. A few areas are in native grass. The soil has good potential for cultivated crops, grass, and trees. The potential is fair for most engineering uses.

This soil is well suited to corn, grain sorghum, and wheat. It is suited to alfalfa, but it generally needs to be limed. It is subject to soil blowing and water erosion. Controlling erosion is the main concern in management. Conserving moisture and maintaining the content of organic matter and fertility are other concerns. Keeping tillage to a minimum and returning all crop residue to the soil help control erosion. Terraces and contour farming help control water erosion. Planting crops in sequence helps reduce plant disease and insect carryover. The content of organic matter and fertility of the soil can be improved by applications of barnyard manure. This soil is suited to furrow, border, or sprinkler irrigation. Some land shaping is needed for gravity irrigation.

Tame grass pasture reduces the hazard of soil blowing and water erosion by providing a protective cover. However, excessive trampling by livestock during the winter can damage the turf.

Areas in native grass are generally adjacent to steeper soils that are less suited to cultivated crops than Judson

soil. Native range can be protected by proper grazing use, deferred grazing, and a planned grazing system. Weeds and brush can be controlled by good range management, but use of chemicals may be needed in a few areas. Eroded areas can be seeded to native grasses and fenced to keep livestock from damaging the seedlings.

This soil provides good sites for windbreaks. Adapted species have fair capability for survival and growth. Lack of moisture and soil blowing are the principal hazards. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows.

The diverse vegetation on this soil supplies food and cover for many kinds of wildlife, for example, cottontail rabbits, pheasant, bobwhite quail, deer, and many species of birds.

Most garden crops grow well on this soil. The upper 2 feet of the soil is good potting material.

This soil generally provides good building sites; however, runoff from higher adjacent soils can be a hazard. Sloping the soil away from the buildings helps to control runoff and avoid seepage into basements. This soil is commonly suited to septic tank absorption fields, but percolation tests need to be made before installation. It is not suited to sewage lagoons unless the slope is altered. Roadcuts should be seeded to grass to prevent soil blowing and water erosion. Covering the bare soil with straw or native hay may be needed.

This soil is in capability units IIe-3 dryland and IIe-5 irrigated. It is in Silty range site and windbreak suitability group 3.

JuC—Judson silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on colluvial foot slopes. Areas are long and narrow and range from 5 to 200 acres.

Typically, the surface layer is about 29 inches thick. The upper part is very dark brown, friable silt loam; the next part is black, friable silt loam; and the lower part is very dark grayish brown, friable silty clay loam. The subsoil is dark brown, firm silty clay loam about 26 inches thick. The underlying material, to a depth of 60 inches, is brown silty clay loam. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Nodaway soils and Sharpsburg soils. Nodaway soils are in natural drainageways and are occasionally flooded. Sharpsburg soils are generally higher in elevation than Judson soils and have a finer textured subsoil. These areas make up 10 to 20 percent of the map unit.

This Judson soil has moderate permeability. Runoff is medium. Available water capacity is high, and content of organic matter is moderate. Natural fertility is high. Tilth is generally good, and the soil is easily tilled through a fairly wide range of moisture content. Moisture is absorbed, stored, and released readily to plants. The surface layer is strongly acid or medium acid. Shrink-swell potential is moderate.

Most of the acreage of this soil is used for cultivated crops. Small tracts are used as range, especially those areas that are adjacent to native grass. This soil has good potential for cultivated crops, grasses, and trees. It has fair potential for most engineering uses and recreation uses.

This soil is well suited to corn, grain sorghum, soybeans, and wheat. Alfalfa is also suited, but the soil generally needs to be limed. Return of crop residue to the soil helps to increase the intake rate of water, maintains the content of organic matter, improves the soil structure, and maintains good soil tilth (fig. 8). Farming on the contour helps to control runoff and erosion. Diversion terraces can protect this soil and the adjacent bottom lands from concentrated runoff from nearby uplands. This soil is suited to gravity and sprinkler irrigation. If the land is leveled sufficiently to prevent runoff and control erosion, it is also suited to furrow and border irrigation. Contour bench leveling can be used on this soil.

This soil responds well to applications of fertilizer, and it is well suited to such cool-season pasture grasses as bromegrass, orchardgrass, and reed canarygrass. If pasture production declines, the old stand can be plowed under and desirable grasses reestablished. Cool-season grasses respond well to nitrogen applied early in spring. If a legume is included in the pasture mixture, phosphate fertilizer may be needed.

This soil is suitable for rangeland. Controlled grazing and proper placement of water and salting facilities to encourage distribution of grazing are suitable range management practices.

This soil provides good sites for windbreaks. Planting on the contour helps to reduce erosion. Although they are not generally planted in windbreaks, Colorado blue spruce and black walnut grow well on this soil.

Wildlife that use this soil are mainly upland game birds and deer. Pheasants are common. Crop seeds supply food and crop residue provides protection for wildlife. Close tillage and clean harvesting tend to reduce the available food supply.

Most garden crops and blue grass lawns grow well in this soil. The upper 2 feet of the soil is good potting material.

Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Reinforced concrete can be used in wall construction. Replacing the abutting soil material with material that has little or no content of clay and low shrink-swell may be feasible. This soil is suited to septic tank absorption fields. Slope needs to be altered for sewage lagoons. Construction of roads and streets is limited because of frost action and shrink-swell potential. Strengthening or replacing the base material can overcome these limitations.

This soil is in capability units IIe-1 dryland and IIIe-4 irrigated. It is in Silty range site and windbreak suitability group 4.

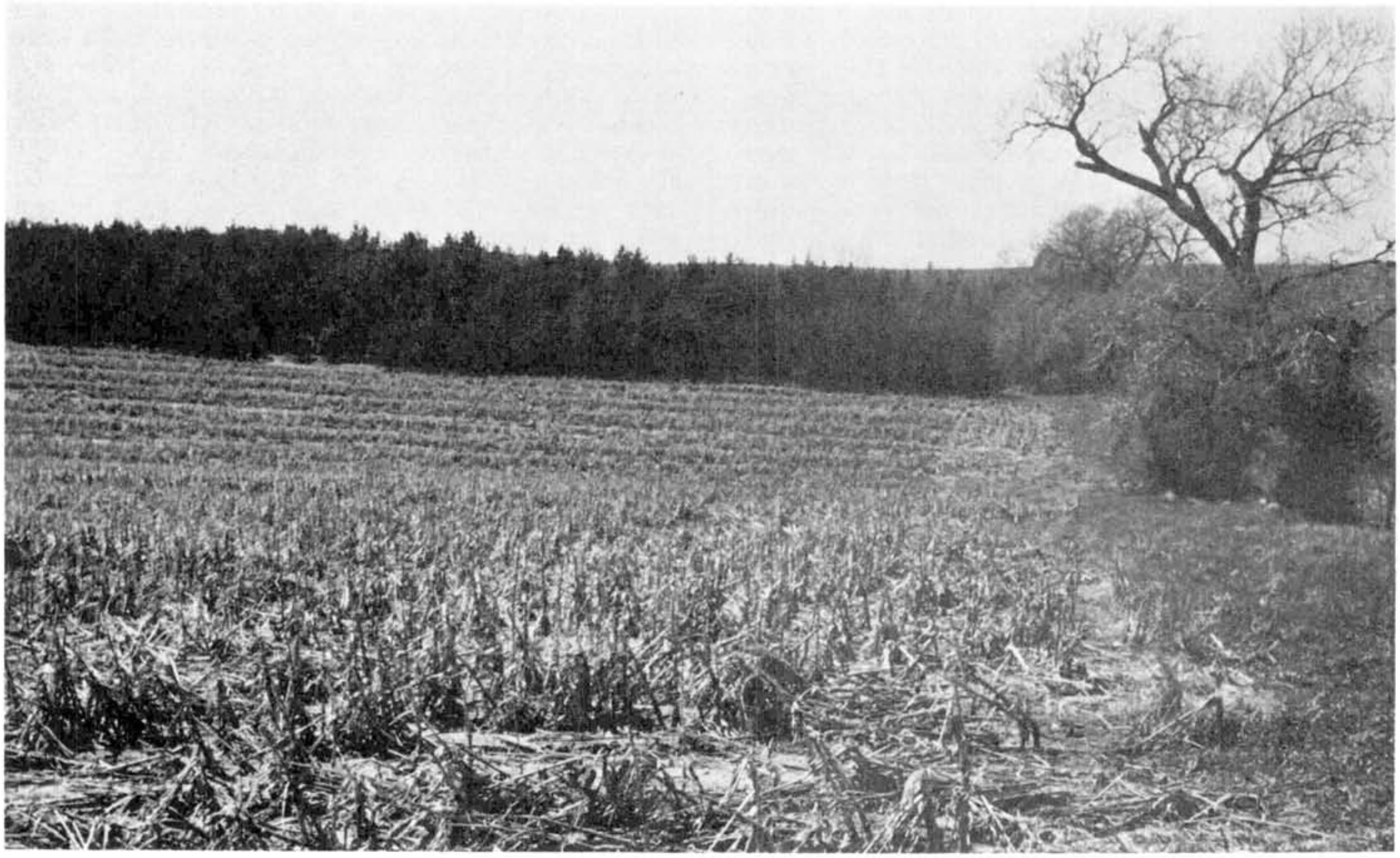


Figure 8.—Crop residue on the surface protects the soil from water erosion and soil blowing on Judson silt loam, 2 to 6 percent slopes.

Ke—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom lands. It is occasionally flooded. Areas are long and range from 5 to 300 acres.

Typically, the surface layer is very dark gray, friable silt loam in the upper 19 inches and black, firm silty clay loam in the lower part. The bottom layer, to a depth of 60 inches, is very dark gray, firm silty clay loam. In places, the surface layer is 15 to 30 inches thick.

Included with this soil in mapping are small areas of somewhat poorly drained and poorly drained Colo soils and Zook soils that are lower in elevation than Kennebec soils. They make up 5 to 20 percent of the map unit.

This Kennebec soil has moderate permeability and high available water capacity. Runoff is slow. Natural fertility is high, and content of organic matter is moderate. This soil is easily tilled through a fairly wide range in moisture content. The seasonal high water table is 4 to 6 feet below the surface. The shrink-swell potential is moderate.

Most of the acreage of this soil is cultivated. This soil has good potential for cultivated crops, grasses, and trees in windbreaks. The potential is fair for most recreation uses. Because this soil is subject to flooding, the potential is poor for most engineering uses.

This soil is suited to corn, grain sorghum, soybeans, and wheat. Crops respond well to applications of nitrogen fertilizer. Lime helps to neutralize acidity; the amount of lime needed should be determined by soil tests. Diversion terraces on higher adjacent areas help to protect this soil from flooding, and grassed waterways can be used to help carry the runoff from the diversion terraces. If an adequate supply of water is available, this soil is well suited to all systems of irrigation. Reuse pits help to eliminate waste of water. Applications of irrigaton water should be timely and in proper amount.

Bromegrass, orchardgrass, and reed canarygrass are introduced pasture grasses that grow well in this soil. Native grasses also grow well and provide a dependable source of forage during summer months. Invading trees need to be controlled.

This soil provides good sites for windbreaks. Adapted trees have a good chance for survival and growth, if they are not subjected to excessive competition from weeds and grasses for the available moisture. Although black walnut trees are not commonly used in windbreaks, they are well adapted to this soil. This soil supplies good potting material around newly planted trees in lawns.

This soil is well suited to the most commonly grown garden plants. Bluegrass is well adapted, and the sod can be removed without hazard of severe erosion.

This soil supplies abundant food and cover for most kinds of wildlife in the county because herbaceous and woody plants are plentiful.

This soil is poorly suited to homesites, septic tank absorption fields, and sewage lagoons because of flooding. Construction of roads and streets is limited because of frost action and the moderate shrink-swell characteristic of this soil. Strengthening or replacing the base material is needed. The water table can be a hazard if deep excavations are made.

This soil is in capability units I-1 dryland and I-6 irrigated. It is in Silty Lowland range site and windbreak suitability group 1

Lm—Lamo silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom lands of major streams that drain into Salt Creek. The soil is occasionally flooded. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the calcareous surface layer is black, friable silty clay loam about 29 inches thick. Beneath this is a transitional layer of very dark gray, friable silty clay loam about 5 inches thick. The underlying material, to a depth of 60 inches, is olive gray silty clay loam.

Included with this soil in mapping are small areas of Kennebec soils that are better drained and at a higher elevation than Lamo soil. Also included are less than 10 percent Salmo soils on poorly drained areas. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in this Lamo soil, and runoff is slow. Reaction is mildly alkaline or moderately alkaline. Available water capacity is high, and moisture is released readily to plants. Natural fertility is medium, and content of organic matter is moderate or high. The seasonal high water table ranges from 2 to 3 feet below the surface.

Most of the acreage of this soil is cultivated; however, about 40 percent of the area is in native grass and is used for grazing. This soil has fair potential for cultivated crops and trees and good potential for grasses and wildlife habitat. It has poor potential for most engineering uses.

This soil is suited to corn, grain sorghum, and soybeans. Winter wheat and alfalfa are also grown; however, flooding in early spring can be a hazard. Terraces, diversion ditches, and grassed waterways on adjacent soils at higher elevation reduce runoff and help lessen flood damage on this soil. This wet soil warms up slowly in spring. Wetness caused by the water table is the principal concern of management. When the water table is highest, this soil is difficult to cultivate. Wetness can be reduced by open drains or tile drains if adequate outlets are available. In dry years the high water table is beneficial to crops. Available phosphorus may be low in this soil. Sprinkler and gravity irrigation systems can be used. Application of water should not exceed the intake rate of the soil.

Less productive plants, for example, Kentucky bluegrass, dandelion, ragweed, and blue verbena invade the range if it is overgrazed. Reed canarygrass and tall fescue are introduced pasture species that grow well. Trampling by livestock can damage the turf if grazing is permitted during wet periods. Distribution of livestock in the pasture can be improved by proper placement of fences, water supplies, and salting facilities.

Some areas of this soil are near intermittent ponds and marshes. These areas supply food for waterfowl. Habitat is good for rangeland and openland wildlife.

This soil is well suited to eastern cottonwood, eastern red cedar, Austrian pine, and green ash for windbreaks. Black walnut trees grow fairly well in this soil, but they are not used for windbreaks. Such shrubs as chokecherry, American plum, and redstem dogwood also grow well. Establishment of trees can be difficult during wet years. The abundant and persistent herbaceous vegetation competes with the young trees and makes cultivation between the tree rows difficult. Although this soil provides good planting sites, few trees are planted.

Because of flooding and wetness, this soil is poorly suited to campsites. It has moderate limitations for use as picnic grounds. Mosquitoes need to be controlled with chemicals in summer.

This soil is poorly suited to homesites, septic tank absorption fields, and sewage lagoons because of flooding and wetness. Local roads need to be graded to shed rainwater. Because this soil has high shrink-swell potential, a more suitable base material may be needed. Buried steel pipes should be coated to prevent corrosion. If ponds are excavated in the wetter parts of the map unit, embankments should be built around the pond to prevent damage from flooding.

This soil is in capability units IIw-4 dryland and IIw-3 irrigated. It is in Subirrigated range site and windbreak suitability group 2.

McD—Malcolm silt loam, 6 to 11 percent slopes. This deep, strongly sloping, somewhat excessively drained soil is on ridgetops and side slopes of uplands. A few stones are on the surface. Areas are irregular in shape and range from 3 to 25 acres.

Typically, the surface layer is friable silt loam about 11 inches thick. The upper part is black, and the lower part is very dark brown. The subsoil is friable silt loam about 23 inches thick. The upper part is very dark grayish brown, and the lower part is brown. The underlying material is silt loam to a depth of 60 inches. It is brown in the

upper part and pale brown in the lower part. In places, the underlying material is very fine sandy loam that has strata of sandier material.

Included with this soil in mapping are small areas of clayey Pawnee soils and areas of Sharpsburg soils that are generally higher in elevation than Malcolm soil. These soils make up 10 to 20 percent of the map unit.

This Malcolm soil has moderate permeability. Runoff is medium. Available water capacity is high. Content of organic matter is generally moderate; however, it is moderately low on some cultivated areas that have eroded. Natural fertility is medium. Reaction of the surface layer is slightly acid or medium acid. Moisture is released readily to plants. This soil is easily worked. Shrink-swell potential is low or moderate.

About 60 percent of the acreage of this soil is in native grass. The rest is used mainly for cultivated crops. This soil has good potential for grass and windbreaks. The potential is fair for cultivated crops and for most engineering uses. Irrigation generally is not well suited because of excessive slope and a high erosion potential.

If this soil is cultivated, a cropping system can be used that consists mainly of close growing crops; for example, wheat, alfalfa, or a legume-grass mixture. The soil needs to be limed if legumes are grown. The soil is suited to corn and sorghum; however, use of row crops should be limited. Terraces, grassed waterways, and contour farming help to control runoff and erosion. Stones generally need to be removed if an area in native grass is plowed. This soil is poorly suited to sprinkler irrigation. Application of water should not exceed the intake rate of the soil. If intensive management and a suitable cropping sequence cannot be used, the soil is better suited to permanent grasses.

This soil is well suited to range, and this use effectively helps to control erosion. Proper grazing use, deferred grazing, and a planned grazing system help keep the range in good condition.

This soil provides good sites for windbreaks. Susceptibility to water erosion and moisture competition from grasses and weeds are principal hazards to establishment of seedlings. Placing tree rows on the contour and planting a cover crop between the rows helps to reduce erosion.

Because of slope, this soil has fair suitability for building sites. Slope steepness needs to be reduced for installation of septic tank absorption fields and sewage lagoons. Trench lines should be installed on the contour. Seepage is a problem if this soil is used as material in a dam because the clay content is commonly too low to form a seal with soda ash.

This soil is in capability units IVe-1 dryland and IVe-6 irrigated. It is in Silty range site and windbreak suitability group 4.

McF—Malcolm silt loam, 11 to 25 percent slopes. This deep, moderately steep to steep, somewhat excessively drained soil is on narrow ridgetops and side slopes of uplands. A few stones and boulders are on the surface. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is friable silt loam about 10 inches thick. The upper part is black, and the lower part is very dark brown. The subsoil is friable silt loam about 18 inches thick. The upper part is very dark grayish brown, and the lower part is brown. The underlying material is pale brown to a depth of 60 inches. The upper part is silt loam, and the lower part is very fine sandy loam. In places, the underlying material has strata of fine sandy loam, loamy fine sand, or fine sand.

Included with this soil in mapping are small areas of clayey Pawnee soils and Sharpsburg soils and calcareous Steinauer soils. The Pawnee, Sharpsburg, and Steinauer soils are on upper side slopes and ridges. These soils make up 5 to 20 percent of the map unit.

This Malcolm soil has moderate permeability. Runoff is rapid. Available water capacity is high, and content of organic matter is moderate. Natural fertility is medium. Reaction of the surface layer is slightly acid or medium acid. This soil absorbs moisture easily and releases it readily to plants. The shrink-swell potential is low or moderate.

Nearly all of the acreage of this soil is in native grass. This soil has good potential for grass and trees and shrubs in windbreaks, poor potential for cultivated crops and for most engineering uses, and good potential for rangeland wildlife habitat.

This soil is poorly suited to cultivated crops because of steep slopes and the hazard of erosion. Downstream siltation is a hazard if the soil is cultivated.

Good rangeland managment is needed. A plant cover that protects the soil from erosion and at the same time produces a high yield of forage is desirable. Grazing should be controlled. A healthy stand of grass can be maintained if only half of the grass forage is harvested each year. Overgrazed areas are easily invaded by Kentucky bluegrass and weeds such as western ragweed and blue verbena. The few large stones on the surface can be a hazard to equipment if the grass is cut for hay.

Trees can be grown in windbreaks; however, water erosion is a hazard. Because of rapid runoff, lack of sufficient moisture reduces growth of trees. Planting trees on the contour reduces runoff and helps to control water erosion.

Habitat for songbirds, rabbits, squirrels, and deer is provided if a productive rangeland is maintained, and if trees and shrubs are planted.

This soil has severe limitations for building sites because of the slope gradient. It is not suited to sewage lagoons and septic tank absorption fields unless the slope is modified. A few large stones on the surface may be used as ornamentals in lawns. Seepage is a problem if this soil is used in a dam because of the strata of sandy material. The clay content is often too low to form a seal with soda ash. Because this soil is erodible, roadbanks need to be planted to a well adapted grass or grass mixture and the slope kept to the minimum grade.

This soil is in capability unit VIe-1 dryland. It is in Silty range site and windbreak suitability group 4.

MeC2—Mayberry silty clay loam, 2 to 7 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on side slopes and ridgetops. In some areas a few pebbles are on the surface. Cracks 1 to 2 inches wide are common during dry periods. Areas are irregular in shape and range from 3 to 100 acres. Areas that are slightly eroded and have never been cultivated make up 5 percent of this map unit.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is about 51 inches thick. The upper part is dark brown, friable silty clay loam; the middle part is reddish brown, firm clay; and the lower part is brown, firm clay loam. The lower part of the subsoil has yellowish red mottles. The underlying material, to a depth of 60 inches, is strong brown clay loam. It has a few small lime concretions in places. In some areas, the surface layer is clay loam. In other areas, the upper part of the subsoil is silty clay or clay.

Included with this soil in mapping are small areas of well drained Geary soils. Geary soils are at a higher elevation than Mayberry soil. They make up 5 to 15 percent of each mapped area. Also included are small, severely eroded areas that have the clay or silty clay subsoil exposed.

This Mayberry soil has slow permeability and moderate available water capacity. Runoff is medium. The surface layer is medium acid or slightly acid. Content of organic matter is moderate, and natural fertility is medium. The clay subsoil somewhat limits root penetration and restricts water movement. Moisture is released slowly to plants. The content of phosphorus is generally low. Cracks that develop in the soil during dry periods increase the water intake when rainfall occurs. This soil is fairly hard to work in places. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. This soil has fair potential for cultivated crops and grass and for wildlife habitat. The potential is poor for tree windbreaks. It is poor for most engineering uses because of the shrink-swell characteristic.

This soil is best suited to grain sorghum and small grain. These crops can be rotated with alfalfa. Lack of lime in the surface layer hinders the establishment of legumes. The main management concern is control of water erosion. Terraces, contour farming, grassed waterways, and the use of crop residue as a mulch help to reduce runoff and control erosion. A cropping system that limits the years of consecutive row crops and that includes such close growing crops as small grain and alfalfa helps to control erosion and to conserve water. A few areas are irrigated by center-pivot irrigation systems. Because of the slope of this soil, the hazard of erosion is increased by natural rainfall and application of irrigation water. Rates of water application need to be carefully controlled so that they do not exceed the intake rate of this soil.

Bromegrass is most commonly grown in tame pasture. If tall fescue and such legumes as alfalfa and birdsfoot trefoil are added to bromegrass, the pasture crop can have more extensive use and more consistent production than pasture consisting of a single species. When pasture production declines, the old stand can be plowed under and desirable grasses reestablished. Cool-season grasses respond well to nitrogen applied early in spring. If a legume is included in the pasture mixture, phosphate fertilizer is needed for high production. Gullies are common in overgrazed pasture.

Areas in native grass are generally adjacent to soils that are not well suited to cultivation. The use of proper grazing, deferred grazing, and planned grazing systems maintains or improves the condition of range. The distribution of livestock in a pasture can be improved by proper placement of fences and watering and salting facilities.

This soil has poor sites for windbreaks. Drought and moisture competition from weeds and grasses are the principal hazards. Tree growth is difficult to sustain because the soil is droughty during dry periods. The use of friable, dark potting soil helps trees and shrubs planted in lawns to obtain moisture and nutrients more readily.

Bobwhite quail and ring-necked pheasants are common in areas of this soil. Windbreaks provide habitat for deer and quail. This clayey soil has moderate or severe limitations for recreation uses.

Disturbed areas of soil around building sites can be improved if the dark surface layer that was removed is stockpiled and spread on the surface after construction. Bluegrass lawns are difficult to maintain on areas where the clay subsoil has been exposed. Basements commonly need tile drains around footings to prevent seepage. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Reinforced concrete can be used in wall construction. This soil is poorly suited to septic tank absorption fields because of slow permeability. Sites for sewage lagoons are limited because of slope. Areas of exposed shale shown on the soil map by spot symbols are poor sites for buildings. Roads built on this soil dry slowly following rain unless the roadbeds are elevated and covered with gravel or limestone.

This soil is in capability unit IIIe-2 dryland and IVe-1 irrigated. It is in Clayey range site and windbreak suitability group 9.

MeD2—Mayberry silty clay loam, 7 to 11 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on side slopes of uplands. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is firm, very dark grayish brown, silty clay loam about 7 inches thick. The subsoil is about 40 inches thick. The upper part is dark brown,

firm clay; the next layer is reddish brown, very firm clay; and the lower part is brown, firm clay loam. The underlying material is brown clay loam to a depth of 60 inches. It has dark grayish brown mottles. In places, this soil has a silty clay subsoil; in places, the lower part of the subsoil and the underlying material have a few small lime concretions. In other places, this soil is severely eroded and the clay subsoil is exposed at the surface.

Included with this soil in mapping are small areas of well drained Morrill soils on lower slopes. They make up 5 to 15 percent of each mapped area.

This Mayberry soil has slow permeability. Runoff is rapid, and available water capacity is moderate. Content of organic matter is moderate; however, it is moderately low on severely eroded areas. Natural fertility is medium. The surface layer is medium acid or slightly acid. The clayey subsoil somewhat limits root penetration and restricts water movement. Water is released slowly to plants. The content of nitrogen and available phosphorus is generally low. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. The soil has poor potential for the commonly grown cultivated crops and fair potential for grass. It has fair potential for wildlife habitat. The potential is poor for most engineering uses and for trees.

If an adequate amount of moisture is maintained in the soil, small grain, legumes, and grain sorghum grow fairly well. If alfalfa is grown, the soil generally needs to be limed. The main concern of management is control of runoff and erosion. A cropping system that restricts row crops and includes close growing crops, legumes, and grasses helps to control erosion. Terraces, grassed waterways, contour farming, and use of crop residue as mulch also help to control runoff and erosion. During dry seasons this soil becomes hard, develops cracks, and is droughty. Because of the slow rate of water release in this soil, heavy applications of fertilizer can damage crops during dry years. Tillage is difficult because of the moderately fine texture of the surface layer. Tilth can be improved or maintained by keeping tillage to a minimum. This soil is poorly suited to irrigation.

The hazard of water erosion can be reduced if this soil is converted to grassland and used for pasture or range. About half of the yearly plant growth needs to be left on the soil after the growing season to help control water erosion. Bromegrass or a mixture of bromegrass-alfalfa is mainly used in cool-season pasture. Areas can be converted to range by seeding to native grass. Gullies should be reshaped and reseeded and protected by grade-control and erosion-control structures.

This soil provides poor sites for windbreaks. Drought and moisture competition from weeds and grasses are the principal hazards. Absorption and release of moisture are too slow to sustain good tree growth. Planting windbreaks on the contour helps to control erosion.

The wildlife on this soil are mostly upland game birds. The hazard of erosion and the clayey texture of the soil are moderate to severe limitations if recreation areas are developed on this soil.

Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Reinforced concrete can be used in wall construction. Land shaping is generally needed to provide a suitable building site. The surface should be topdressed with dark soil that has a higher content of organic matter and higher fertility than the reddish brown subsoil. This soil is poorly suited to septic tank absorption fields because of slow permeability. It is not suited to sewage lagoons unless the slope is modified. This soil has limitations for the construction of roads because of the shrink-swell characteristic. Replacement or modification of soil material can be needed. Placing roads on the contour reduces erosion.

This soil is in capability unit IVe-2 dryland. It is in Clayey range site and windbreak suitability group 9.

MhC3—Mayberry clay, 2 to 7 percent slopes, severely eroded. This gently sloping, moderately well drained soil is on side slopes and ridgetops. Pebbles and stones are on the surface in places. If this soil becomes dry, 1- to 2-inch cracks commonly appear in the surface. Areas are irregular in shape and range from 3 to 60 acres.

Severe water erosion has removed most of the original clay loam surface layer. The present surface layer is brown, firm clay about 6 inches thick. The subsoil is reddish brown, very firm clay about 31 inches thick. The underlying material, to a depth of 60 inches, is reddish brown clay. It is clay loam in places. In a few areas, the surface layer is very dark grayish brown, brown, and dark brown silty clay loam, clay loam, or silty clay. Numerous rills and small gullies are common.

Included with this soil in mapping are small areas of well drained Geary soils and Morrill soils. Geary soils are at the higher elevations in the map unit. Morrill soils are on the steeper slopes. These areas make up 5 to 15 percent of each mapped area.

Permeability is slow in this Mayberry soil, and available water capacity is moderate. The content of organic matter is moderately low, and natural fertility is medium. Content of nitrogen and available phosphorus is generally low. This soil has poor tilth and is difficult to work. Reaction of the surface layer is slightly acid or medium acid. Moisture is absorbed and released slowly. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of the acreage of this Mayberry soil is cultivated. Some areas have been reseeded to grass. This soil has poor potential for cultivated crops. It is suited to pasture, range, and rangeland wildlife habitat. The potential is poor for recreation and for most engineering uses because of the high content of expandable clay. This soil has poor potential for trees.

This soil can be used for cultivated crops; however, it is poorly suited to this use. Wheat, alfalfa, and grain

sorghum are the most productive crops and are most often grown. A cropping system that limits the years of consecutive row crops in the rotation and provides more time for close growing crops that resist erosion is desirable. Because this soil is sticky when wet and hard when dry, it needs to be tilled at the proper moisture content. Protecting the soil against further erosion is essential. Terracing and contouring are needed. Grassed waterways provide safe disposal of excess runoff. Use of green manure crops and barnyard manure improves the content of organic matter and tilth of the soil. Unless intensive management is maintained and a suitable cropping sequence is practiced, this soil is better suited to permanent grass than to cultivation.

Tame grass pasture can be grown in rotation with cultivated crops to supplement native range and provide a longer grazing period. The most desirable grasses can be maintained if the range is not overgrazed. Range in good condition reduces runoff and erosion. Gullies are common in overgrazed pastures.

This soil provides poor sites for windbreaks. The moderate available water capacity limits tree growth. Windbreaks need to be planted on the contour to reduce water erosion.

Conservation methods that help to protect and improve the soil and to conserve moisture also improve food and cover for wildlife. Wheat and grain sorghum supply food for pheasants.

Foundation and basement walls need to be designed to withstand the shrinking and swelling of the soil. Artificial drainage, footing drains, and basement sump pumps reduce or overcome wetness. This soil is poorly suited to septic tank absorption fields because of slow permeability. It has limitations for sewage lagoons unless the slope is modified. Because this soil becomes sticky when wet, digging is difficult. It is poorly suited to lawns and gardens. Tilth and available moisture can be improved by topdressing the soil with friable, dark soil.

Roads built on this soil dry slowly after rainfall unless the roadbed is elevated and covered with gravel or limestone. Roadbanks need to be planted to a well adapted grass or grass mixture and the slope kept to a minimum.

This soil is in capability unit IVe-4 dryland. It is in Dense Clay range site and windbreak suitability group 9.

MrD—Morrill clay loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on side slopes of uplands. A few small stones and coarse pebbles are on the surface. Areas are irregular in shape and range from 3 to 150 acres.

Typically, the surface layer is dark brown, friable clay loam about 8 inches thick. The subsoil is clay loam about 43 inches thick. The upper part is friable and dark reddish brown, the middle part is firm and reddish brown, and the lower part is firm and brown. The underlying material, to a depth of 60 inches, is brown clay loam.

Included with this soil in mapping are small areas of fine textured Mayberry soils and Sharpsburg soils. Sharpsburg soils are on upper side slopes at a higher elevation than Morrill soils. Mayberry soils are less sloping. These soils make up 10 to 20 percent of the map unit. Also included are small areas of soils that have a sandy to loamy surface layer and subsoil.

Permeability is moderately slow in this Morrill soil, and runoff is medium. Content of organic matter is moderate, and natural fertility is medium. Available water capacity is high. The surface layer is medium acid and friable. Shrink-swell potential is moderate.

Most of the acreage of this soil is cultivated. Very few areas are irrigated. This soil has good potential for cultivated crops, pasture, range, trees, and rangeland wildlife habitat. The potential is fair for recreation and for most engineering uses.

This soil is suited to corn, grain sorghum, soybeans, and small grain. Control of water erosion is the main management concern. A cropping system that limits the years of consecutive row crops and that includes such close growing crops as small grain and grasses helps to control erosion and conserve water. Terraces, contour farming, grassed waterways, and the use of crop residue as a mulch help to reduce runoff and control erosion. Application of lime helps to neutralize the acidity of this soil; the amount of lime needed should be determined by soil tests. This soil is poorly suited to irrigation. Because of slope, the hazard of erosion is increased by natural rainfall or by the application of irrigation water. Bromegrass, orchardgrass, tall fescue, and reed canarygrass grow well in irrigated pasture.

Big bluestem, Canada wildrye, switchgrass, and indiangrass are productive native grasses in rangeland. If grazing increases, blue grama, buffalograss, and western wheatgrass increase. Overgrazed areas are invaded by Kentucky bluegrass, blue verbena, and many annuals. Range management should include proper grazing use, deferred grazing, and a planned grazing system. Rangeland in good condition provides good habitat for rangeland wildlife.

Trees for planting in windbreaks are hackberry, green ash, and most conifers common to the area. Honeylocust, red oak, and Colorado blue spruce are acceptable species; however, they are generally planted in parks and lawns rather than in windbreaks. Shrubs provide habitat for wildlife and are commonly used in tree windbreaks as well as in lawns. Cotoneaster, lilac, honeysuckle, chokecherry, and American plum grow well in this soil. Tree windbreaks should be planted on the contour to help control erosion.

This soil has moderate limitations for building sites. Moderate shrink-swell potential of the subsoil is the main limitation. Foundations and footings for dwellings should be properly designed to prevent structural damage caused by shrinking and swelling of the soil.

Buildings with basements commonly need tile drains around the footings to prevent seepage from water perched on top of the underlying glacial till. This soil is poorly suited to septic tank filter fields because of mod-

erately slow permeability. It is not suitable for sewage lagoons unless the slope is modified. Because this soil is erodible, roadbanks should be planted to a well adapted grass or grass mixture and the slope kept to a minimum grade.

This soil is in capability units IIIe-1 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

MrD2—Morrill clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on narrow ridges and side slopes of uplands. Pebbles are on the surface in places. Areas are irregular in shape and range from 3 to 120 acres.

Typically, the surface layer is brown, friable clay loam about 6 inches thick. It includes only the plow layer, because most of the original surface layer has been removed by water erosion. The subsoil is reddish brown, firm clay loam about 26 inches thick. The underlying material, to a depth of 60 inches, is reddish brown clay loam. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of fine textured Mayberry soils and Sharpsburg soils. Sharpsburg soils are on upper side slopes at a higher elevation than the Morrill soil. Mayberry soils are on less sloping areas on the side slopes. These soils make up 10 to 20 percent of the map unit in most places.

This Morrill soil has moderately slow permeability and high available water capacity. Runoff is rapid. Content of organic matter is moderately low, and natural fertility is medium. Content of nitrogen and available phosphorus is generally low. Reaction of the surface layer is slightly acid. Moisture is released readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is used for cultivated crops, but a few areas have been seeded to native or tame grass. This soil has good potential for grass and trees. The potential is poor for cultivated crops and fair for wildlife habitat and for most engineering uses.

This soil is suited to close growing crops, for example, winter wheat and alfalfa. It is suited to limited use of such row crops as corn and grain sorghum. A cropping system is needed that provides the maximum amount of crop residue for use as surface mulch. Applications of commercial fertilizer or barnyard manure are needed to increase and maintain the fertility of the soil. Corn and grain sorghum generally respond to addition of nitrogen fertilizer, and most crops respond to added available phosphorus. Terraces, grassed waterways, and contour farming are needed to control erosion and runoff. This soil is poorly suited to irrigation. However, if irrigation is used, sprinkler irrigation is preferable to other systems. Irrigated areas can be used for hay crops such as alfalfa and grasses. Rates of water application need to be controlled to prevent excessive runoff and erosion.

Tame grass pasture can be grown in rotation with cultivated crops. Bromegrass is the best species for planting; however, orchardgrass, tall fescue, and reed canarygrass are also well adapted. The best seeding results are obtained if old stands are plowed under when they begin to deteriorate. Pasture grasses should attain a height of 5 or 6 inches before they are grazed early in spring, and they should be permitted to attain a height of 6 to 8 inches before a killing frost in fall. During this time of growth, the plants store food for growth the next spring. Weeds can be controlled by use of chemicals. Soil tests and estimates of the amount of available soil moisture should be made to determine the amount and kinds of fertilizer to apply. Grasses commonly need additional nitrogen. If a legume has been included in the pasture mixture, application of phosphate fertilizer is generally essential.

If this soil is reseeded to native grass, a permanent cover should be maintained to help control erosion and excessive runoff. Control of grazing is needed to improve and maintain the most desirable grasses. Salt can be placed so that livestock are attracted to less graded areas, and water facilities and fences can be placed so that grazing is distributed.

This soil provides good sites for windbreaks. It has good potential for the survival and growth of adapted species. Trees should be planted on the contour to reduce the hazard of erosion.

Shrubs planted in windbreaks supply good habitat for wildlife. In addition, pheasants find plentiful food in nearby more fertile soils. Wheat stubble provides nesting areas.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Soil fertility and tilth of lawn and garden areas can be improved by topdressing with dark, friable topsoil or by applications of manure. This soil is well drained; however, during periods of heavy rainfall, water perches on the underlying glacial till material and a few seep spots occur. Artificial drainage, footing drains, and basement sump pumps can be used to control these spots. This soil has severe limitations for septic tank filter fields and sewage lagoons because of moderately slow permeability and slope. The less sloping areas can provide suitable sites for filter fields. Because the slopes are erodible, roadcuts need to be seeded to well adapted grasses. Mulch can be used to help grass become established.

This soil is in capability units IVe-8 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

MrE—Morrill clay loam, 11 to 15 percent slopes. This deep, moderately steep, well drained soil is on side slopes of uplands. Stones and pebbles are on the surface in places. Areas are irregular in shape and range from 3 to 80 acres.

Typically, the surface layer is very dark brown, friable clay loam about 7 inches thick. The subsoil is friable clay loam about 30 inches thick. The upper part is dark brown and the lower part is brown. The underlying material, to a depth of 60 inches, is brown clay loam. In a few

areas, the surface layer is loam. Loam and fine sandy loam strata are common in the underlying material. A few areas have strata of loamy fine sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Burchard soils and fine textured Pawnee soils. Burchard soils and Pawnee soils are on upper side slopes. They make up 5 to 15 percent of the map unit. In places, gravel crops out at the surface. A few areas have sandstone outcrops.

Permeability is moderately slow in this Morrill soil, and runoff is rapid. Content of organic matter is moderate, and natural fertility is medium. Available water capacity is high. The surface layer is medium acid or slightly acid. Moisture is stored well and released readily to plants. Shrink-swell potential is low or moderate.

Most of the acreage of this soil is in native grass; however, a few areas have been planted to trees and are used as parkland. This soil has poor potential for cultivated crops and fair potential for wildlife habitat. The potential is poor for most engineering uses. This soil has good potential for grass production.

This soil is somewhat difficult to till because of slope. Alfalfa grows best. A mixture of alfalfa and grass can be used for pasture or hay. Application of lime is commonly needed. Water erosion is the principal hazard on this soil. Maintaining the content of organic matter and conserving moisture are concerns of management. Terraces, grassed waterways, and contour farming help to control runoff and erosion. Unless intensive management can be maintained and a suitable cropping sequence can be used, this soil is better suited to permanent grasses. Irrigation is not feasible.

Deferred grazing and a planned grazing system help to maintain and improve desirable plant species for range. The distribution of livestock in a pasture can be improved by proper placement of fences, water developments, and salting facilities. Wind and water erosion are hazards in overgrazed areas. Good range management keeps the grass healthy and vigorous, reduces runoff and the hazard of erosion, and increases storage of soil moisture. If native grass is cut for hay, slope and stones on the surface can be safety hazards.

This soil provides good sites for trees to be used for windbreaks or for recreation areas. Tree windbreaks should be planted on the contour to control erosion.

The natural grass vegetation and adjacent cultivated crops provide food and cover for pheasants. Trees that grow naturally along drainageways, and those that are planted in windbreaks provide habitat for deer, quail, squirrel, and cottontail rabbit. Flowering and fruit bearing trees and shrubs also can be planted to help supply food for wildlife.

Building construction on this soil is difficult because of moderately steep slopes. Lots should be landscaped to conform to the terrain. The soil is not well suited to septic tank absorption fields because of moderately slow permeability. In places, sewage systems can be placed on adjacent soils that are less sloping. Sandstone bedrock is a limitation in places where deep excavations are needed. Dam sites need to be examined carefully to exclude sand strata in the embankment material or in the ponding area. Roadbanks should be planted to a well adapted grass or grass mixture and the slope gradient kept to a minimum. Placing roads on the contour reduces roadside erosion.

This soil is in capability unit IVe-1 dryland. It is in Silty range site and windbreak suitability group 4.

No—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom lands of upland drainageways. It is occasionally flooded; however, floodwaters drain away rapidly. Areas are long and narrow and range from 5 to 200 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The underlying material, to a depth of 60 inches, is very dark grayish brown. The upper part is stratified silt loam to a depth of about 45 inches; it is silty clay loam below that depth. Depth to the silty clay loam layer ranges from 20 to more than 60 inches. Because cultivation mixes the light colored strata with darker soil, stratification is not distinct in the plow layer. The soil is generally least stratified in areas that are farthest from streams.

Included with this soil in mapping are small areas of poorly drained Colo soils near the base of adjacent foot slopes. They make up 5 to 20 percent of the map unit.

Permeability is moderate in this Nodaway soil, and runoff is slow. Natural fertility is high, and content of organic matter is moderate. The plow layer is slightly acid. Available water capacity is high. This soil absorbs moisture easily and releases it readily to plants. The seasonal high water table is below a depth of 6 feet.

Most of the acreage of this soil is cultivated. The areas in grass are commonly adjacent to larger tracts of strongly sloping to steep soils that are used for rangeland. This soil has good potential for cultivated crops, grasses, and habitat for wildlife. The potential is poor for most engineering uses because of the hazard of flooding. The potential is good for trees in windbreaks.

This soil is suited to corn and grain sorghum. Small grain and alfalfa tend to be damaged by flooding. Diversion terraces that divert runoff help to protect this soil from flooding, and grassed waterways help carry runoff from the diversion terraces. This soil is well suited to irrigation by sprinkler. Erosion on higher adjacent soils, which results in accumulation of sediment on this Nodaway soil, is a hazard under natural rainfall and applications of irrigation water. The rate of water application needs to be carefully controlled so that it does not exceed the intake rate.

Reed canarygrass is an introduced cool-season species that grows well on this soil. Areas in native grass are generally in fair or poor condition. Overgrazing and siltation from eroding adjacent soils at a higher elevation decrease the more productive grasses such as big

bluestem and switchgrass. Placement of salt blocks on the adjacent steeper soils helps distribute grazing. Chemicals can be used to control troublesome weeds in some areas.

Few trees are planted in windbreaks on this soil because the long narrow shape of the areas is generally unfavorable to planting. However, trees have a good chance for survival and growth if competition from weeds and grasses for available moisture is not excessive. Occasional flooding by runoff from adjacent soils at higher elevation is a hazard.

Dams can be constructed on this soil to establish ponds for livestock and wildlife use. Because the soil is fertile, it generally produces abundant food and cover for many kinds of openland wildlife.

This soil generally is not suited to homesites, septic tank filter fields, and sewage lagoons because of flooding. Roads that cross these areas need to be elevated with fill to prevent damage from floodwaters. This soil provides good material for preparing a seedbed or for topdressing an area where vegetation is to be established and maintained.

This soil is in capability units IIw-3 dryland and IIw-6 irrigated. It is in Silty Overflow range site and windbreak suitability group 1.

Ns—Nodaway silt loam, channeled. This nearly level or very gently sloping, moderately well drained soil is on bottom lands. Areas are dissected by deeply entrenched, meandering streams that have short vertical banks in places. Most of the areas are occasionally flooded, and the areas lowest in elevation are frequently flooded. Debris from flooding is common. Areas are long and range from 10 to 300 acres.

Typically, the surface layer is very dark brown, friable silt loam about 4 inches thick. The underlying material, to a depth of 60 inches, is very dark brown with thin strata of dark grayish brown material. The upper part is silty clay loam and the lower part is silt loam that has thin strata of very fine sand. In places, the surface layer is silty clay loam. In other places, the soil is stratified to the surface.

Included with this soil in mapping are small areas of poorly drained Colo soils and silty Kennebec soils. These soils are in the areas farthest from the streams. They make up 5 to 20 percent of the map unit.

This Nodaway soil has moderate permeability and high available water capacity. Runoff is slow. Content of organic matter is moderate, and natural fertility is high. The seasonal high water table is typically 6 feet below the surface. This soil absorbs moisture easily and releases it readily to plants. Shrink-swell potential is moderate.

Nearly all acreage of this soil is in grasses or is wooded. This soil has poor potential for cultivated crops and for most engineering uses. It has fair potential for recreation uses and grass, and good potential for wildlife habitat. The potential is very poor for tree windbreaks.

Because of the deeply entrenched meandering streams, cultivation is generally not practical.

Growth of the more desirable native grasses is restricted by the tree canopy. Bromegrass and reed canarygrass are among the more productive grasses. Common annual weeds can be controlled by the use of chemicals, but spraying by hand may be required because herbicides can damage the trees. Trees provide livestock with good protection during winter storms.

Tree windbreaks are generally not needed because most areas are naturally wooded. Eastern cottonwood, green ash, boxelder, bur oak, American elm, honeylocust, and black walnut are common. Wooded areas can be improved by restricting grazing, by removing less desirable and poorly formed trees, by supplemental planting, and by pruning. Properly managed stands of black walnut trees are a good source of income.

This soil provides some of the best wildlife habitat in the county. Deer, bobwhite quail, squirrels, and cottontail rabbit are common game species. Mink, muskrat, and beaver are furbearers that live near the water. Other furbearers include raccoon, opossum, and coyote. Although at times water is scarce for furbearers adapted to water habitat, this soil provides abundant habitat for other furbearing animals.

Flooding is a severe hazard for recreational buildings constructed on this soil, and for other recreation uses. However, there are good areas for hunting and nature studies. Some of the larger streams afford fair fishing.

This soil is generally poorly suited to building sites because of the flooding hazard. It is a good source for topsoil. Roads that cross these areas need to be elevated with fill to prevent damage from floodwaters.

This soil is in capability unit VIw-7 dryland. It is in Silty Overflow range site and windbreak suitability group 10.

PaC2—Pawnee clay loam, 2 to 7 percent slopes, eroded. This gently sloping, moderately well drained soil is on side slopes and ridgetops (fig. 9). Pebbles and a few stones are on the surface in places. Cracks 1 to 2 inches wide are common during dry periods. Areas are irregular in shape and range from 3 to 600 acres.

Typically, the surface layer is very dark brown, friable clay loam about 7 inches thick. The subsoil is about 31 inches thick. It is very dark grayish brown, firm clay in the upper part; dark grayish brown, very firm clay in the next layer; olive brown, very firm clay in the next layer; and olive gray, firm clay in the lower part. It has yellowish brown mottles. The underlying material, to a depth of 60 inches, is calcareous, olive clay loam. A few areas which have never been cultivated are slightly eroded. A few areas have a surface layer of silty clay loam that is more than 9 inches thick.

Included with this soil in mapping are small areas of coarser textured Burchard soils on steeper parts of the map unit and Mayberry, Sharpsburg, and Wymore soils on upper side slopes. Also included are areas of frequently flooded Colo soils or Nodaway soils that are intersected with narrow drainageways less than 100 feet wide and areas of severely eroded soils where the

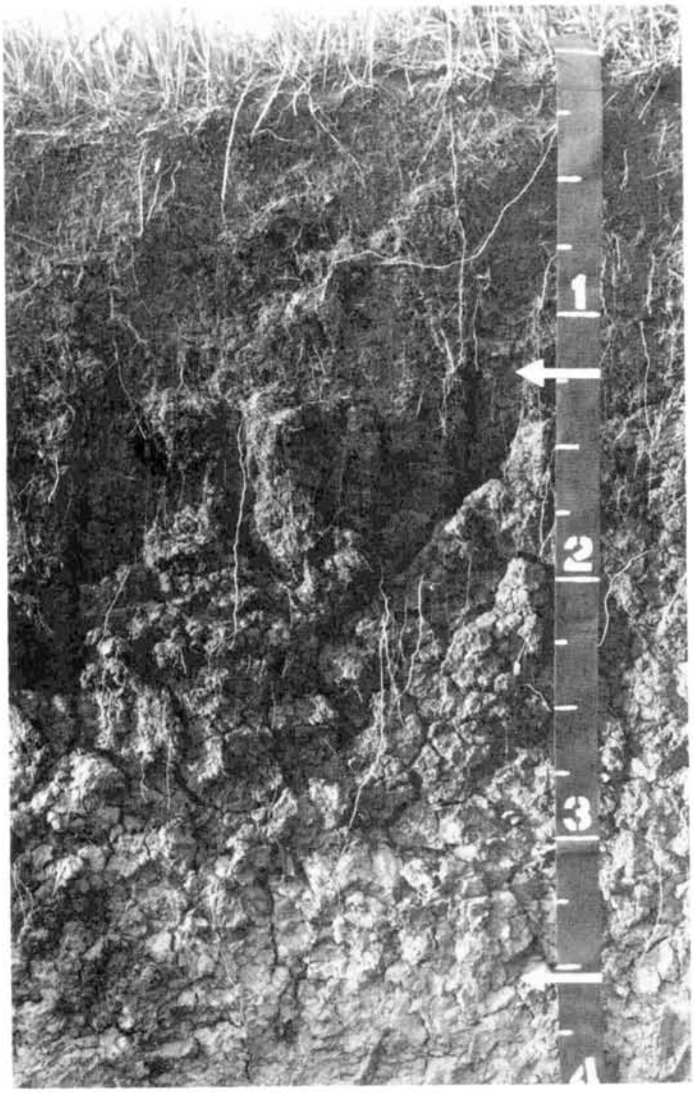


Figure 9.—Profile of Pawnee clay loam, 2 to 7 percent slopes, eroded, that formed in glacial till. Prismatic structure is at a depth of about 13 inches. Lime accumulations are evident below a depth of about 42 inches.

clayey subsoil is exposed at the surface. The included areas make up less than 5 percent of the map unit.

This Pawnee soil has slow permeability and moderate available water capacity. Runoff is medium. Content of organic matter is moderate, and natural fertility is medium. The surface layer is medium acid or slightly acid. The clayey subsoil somewhat limits root penetration and restricts water movement. Moisture is released slowly to plants. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high. Cracks that develop in the soil during dry periods increase water intake during rainfall.

Most of the acreage of this soil is used for cultivated crops. About 10 percent of the acreage is in native grass which has never been farmed and is only slightly eroded. This soil has fair potential for cultivated crops and grass and for wildlife habitat. The potential is poor for most engineering uses and for tree windbreaks.

Grain sorghum and wheat are the chief crops. Corn, alfalfa, and soybeans are also grown. Because this soil releases moisture slowly to plants, it is better suited to sorghum, which tolerates hot dry periods, than it is to corn. Wheat is a cool-season crop that utilizes moisture from spring rains and moisture stored in the soil during the previous season. Because of the erosion hazard and moderate available moisture, the most suitable cropping system consists of wheat and other close growing crops. Row crops can be included in the cropping system if intensive management is practiced. Good management which includes terraces, grassed waterways, and contour farming helps control runoff and erosion. Use of crop residue and applications of fertilizer are needed. A few areas are irrigated with center pivot systems. Water should be applied at a very low rate because water erosion is a severe hazard. Corn and sorghum should not be cut for silage because a cover of crop residue is needed to control erosion and improve water intake during winter and spring.

Bromegrass is an introduced cool-season species that is most commonly used in tame pasture. The addition of alfalfa or birdsfoot trefoil helps to increase forage production. For best results in seeding, old stands should be plowed under when they begin to deteriorate. Tame pastures are best grazed in spring and in fall after the grasses reach a height of 5 or 6 inches. Grazing too early in spring or too late in fall weakens the plants. Sufficient leaf growth is needed for healthy plants and for storing food reserves for the next season. Gullies are common in overgrazed pastures.

Areas of this soil in native grass are generally adjacent to more steeply sloping soils that are used for range. The grass on this gently sloping soil is frequently grazed closer than the vegetation on the steeper areas. Proper placement of salting and watering facilities improves the distribution of grazing by livestock. If this native grass is cut for hay, it provides good feed for horses. Cedar trees, which invade some grassland areas, can reduce the production of forage if they are not controlled.

This soil provides poor sites for windbreaks. Drought and moisture competition from seeds and grasses are the principal hazards. The soil absorbs and releases moisture too slowly to sustain good tree growth. Trees and shrubs planted in lawns can obtain moisture and nutrients more readily if friable, dark potting soil is used.

Wildlife on this soil are mostly upland game birds. Pheasants are common. Some farm ponds have been built along drainageways adjacent to areas of this soil which provide habitat for waterfowl. The hazard of erosion and the fine texture of the soil are moderate to severe limitations for the development of recreation areas.

Basements commonly need tile drains around the footings to prevent seepage. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Replacing the abutting soil material with material having low shrink-swell properties is desirable. Lawn areas can be improved by topdressing with dark, friable soil. This soil is poorly suited to septic tank absorption fields. Sewage lagoons are limited unless slope is altered. This soil has good sites for farm ponds. Because this soil is erodible, roadbanks and roadside drains need to be planted to a well adapted grass or grass mixture and slopes kept to a minimum grade.

This soil is in capability unit IIIe-2 dryland and IVe-1 irrigated. It is in Clayey range site and windbreak suitability group 9.

PaD2—Pawnee clay loam, 7 to 11 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on side slopes of uplands. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the surface layer is very dark brown, friable clay loam about 6 inches thick. The subsoil is about 30 inches thick. It is very dark grayish brown, very firm clay in the upper part; brown, very firm clay in the middle part; and grayish brown, firm clay loam in the lower part. The underlying material, to a depth of 60 inches, is grayish brown, calcareous clay loam that has yellowish brown mottles. A few small areas have more clayey subsoil than is typical.

Included with this soil in mapping are small areas of Burchard, Colo, Judson, and Nodaway soils which have less clay in the subsoil than Pawnee soils. Burchard soils are shallower to carbonates and are on the steeper areas of the map unit. Colo soils and Nodaway soils are on the bottoms of narrow drainageways. Judson soils are on colluvial foot slopes. Also included are severely eroded areas where the clayey subsoil is exposed at the surface. The included areas make up about 10 percent of the map unit.

This Pawnee soil has slow permeability. Runoff is rapid, and available water capacity is moderate. Content of organic matter is moderate; however, it is moderately low on the severely eroded areas. Natural fertility is medium. The surface layer is medium acid or slightly acid. The clayey subsoil somewhat limits root penetration and restricts water movement. The subsoil releases moisture slowly during dry periods. Tillage is difficult because of the moderately fine textured surface layer. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

About 80 percent of the acreage of this soil is used for cultivated crops. The rest of the acreage consists of native grass, reseeded pasture, rangeland, and farmsteads. This soil has fair potential for grass and for wildlife habitat. It has poor potential for cultivated crops. The potential is poor for most engineering uses and for tree windbreaks.

This soil is poorly suited to small grain, legumes, and grain sorghum. If alfalfa is grown, the soil generally needs to be limed. The main concern of management is controlling runoff and erosion. A cropping system that consists mostly of close growing crops, for example, small grain and legumes, should be used. Use of row crops in the cropping sequence should be limited. Terraces, grassed waterways, and contour farming help to control runoff and erosion. Tillage needs to be kept to a minimum to improve tilth. Heavy applications of fertilizer should be avoided in dry years, because the clayey subsoil does not absorb or release enough moisture for plants to utilize the nutrients. This soil is not suited to irrigation.

The hazard of water erosion can be reduced by converting this soil to grassland for pasture or range. About half of the yearly plant growth should be left after each growing season. Bromegrass is mostly used in cool-season pasture. A mixture of bromegrass and alfalfa increases forage production.

Areas can be converted to range by seeding to native grasses. Proper stocking rates, deferred grazing, and a planned grazing system help to keep the grasses in good condition. Overgrazing the range reduces the protective vegetative cover and causes deterioration of the plant community.

This soil provides poor sites for windbreaks. Drought and moisture competition from weeds and grasses are the main hazards. This soil absorbs and releases moisture too slowly to sustain good tree growth. Windbreaks should be planted on the contour to reduce runoff.

The combination of cultivated crops and uncultivated areas provides desirable habitat for many species of wildlife. Farm ponds along the drainageways provide waterfowl with feeding areas. The erodibility and clayey texture of the soil are moderate to severe limitations for recreation development.

This soil provides poor sites for building construction. Basements commonly need tile drains around footings to prevent seepage. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Land shaping is generally needed. The surface should be topdressed with friable, dark soil for lawns. This soil is poorly suited to septic tank absorption fields because of slow permeability, and to sewage lagoons because of slope. It has good sites for farm ponds in places. Because the soil is erodible, roadbanks and roadside drains need to be planted to a well adapted grass or grass mixture and the slope kept to a minimum. Placing roads on the contour helps to reduce erosion.

This soil is in capability unit IVe-2 dryland. It is in Clayey range site and windbreak suitability group 9.

PbC3—Pawnee clay, 2 to 7 percent slopes, severely eroded. This gently sloping, moderately well drained soil is on side slopes and ridgetops. Pebbles are on the surface in places. Cracks 1 to 2 inches wide are common during dry periods. Areas are irregular in shape and range from 3 to 60 acres.

Nearly all of the original surface layer has been removed by water erosion. The present surface layer is firm, very dark grayish brown clay about 6 inches thick. The subsoil is very firm clay about 24 inches thick. The upper part is olive brown and the lower part is light olive brown. The underlying material, to a depth of 60 inches, is light yellowish brown clay loam that has yellowish brown mottles and a few seams of lime. Numerous rills and small gullies are common.

Included with this soil in mapping are small areas of Burchard, Mayberry, and Wymore soils. Burchard soils have less clay in the subsoil than Pawnee soils and are in lower positions in the landscape. Mayberry soils are of redder hue than Pawnee soils and are in similar positions. Wymore soils formed in loess. The included soils make up about 10 percent of map unit.

Permeability is slow in this Pawnee soil, and available water capacity is moderate. Runoff is medium to rapid, depending upon the amount of plant cover. The content of organic matter is moderately low, and natural fertility is medium. This soil has poor tilth and is difficult to work. The surface layer is slightly acid or medium acid. Content of nitrogen is low. Moisture is absorbed and released slowly. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of the acreage of this soil is cultivated. Some areas that were formerly cultivated have been seeded to grass. The potential is poor for cultivated crops. This soil has fair potential for pasture, range, and rangeland wildlife. It has poor potential for recreation and for most engineering uses because of the high amount of clay.

This soil is best suited to wheat, alfalfa, and grain sorghum, and these crops are most often grown. Legumes and grasses should be grown about half of the time and a protective cover crop used the rest of the time. Use of row crops in the cropping sequence needs to be limited. Terraces, sod waterways, and contour farming help to control runoff and erosion. Heavy applications of fertilizer should be avoided in dry years, because this clayey soil does not absorb or release enough moisture for plants to utilize the nutrients. Returning crop residue to the soil and applying barnyard manure improve tilth and increase content of organic matter, fertility, and intake of water. If intensive management and a suitable cropping sequence cannot be used, this soil is better suited to permanent grasses for forage and grazing.

Some areas have been converted to range by seeding to native grass. The most desirable grasses can be maintained by controlled grazing. Rotating the salting facilities on different areas in the pasture helps obtain even distribution of grazing. Range in good condition reduces runoff and erosion and supplies good habitat for rangeland wildlife.

This soil has poor sites for tree windbreaks. Lack of adequate moisture and competition from weeds and grasses are the principal hazards. Erosion is a hazard if cultivation is used to control weeds. Planting on the contour reduces water erosion.

Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Excavation can be difficult in this clayey soil and should be undertaken when the soil is not wet. Footing drains and sump pumps reduce the hazard of wet basements during periods of heavy rainfall. Lawn areas can be improved by topdressing the surface with friable, dark soil. This soil is poorly suited to septic tank absorption fields because of slow permeability. Sewage lagoons can be built in many areas if the slope is modified. Construction of roads is limited because of the shrinking and swelling of the soil. In places, replacement or modification of soil material is required.

This soil is in capability unit IVe-4 dryland. It is in Dense Clay range site and windbreak suitability group 9.

Pt—Pits, quarries. This map unit consists of excavations from which sand, limestone, and overburden are removed. These excavations are in areas of sandy material or in areas that are shallow to limestone bedrock. They range from 5 to 60 acres and are scattered throughout Lancaster County.

The overburden from these excavations is generally stockpiled adjacent to the pits and adds to the rugged appearance of the landscape. In areas where the exposures are fresh, soil blowing is the main hazard. Most of these pits are open and barren.

Unless it is reclaimed, this map unit has limited uses. Overburden can be leveled and planted to such grasses as big bluestem, little bluestem, indiangrass, switchgrass, and sand lovegrass. Cottonwood trees are common invaders where excavations have been abandoned. If vegetation has been reestablished, the pits are well suited to wildlife habitat.

This map unit is in capability subclass VIIIs and windbreak suitability group 10.

Sa—Salmo silt loam, 0 to 2 percent. This nearly level, somewhat poorly drained soil is on bottom lands. Microdepressions are common. The soil is occasionally flooded. Areas are long and range from 5 to 100 acres.

Typically, this soil has about 18 inches of very dark grayish brown silt loam overwash that is stratified with dark grayish brown material. The buried surface layer is about 25 inches thick. The upper part is very dark brown, friable silt loam and the lower part is black, friable light silty clay loam. The next layer is very dark grayish brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is dark grayish brown silt loam. The buried soil is generally calcareous. In places the overwash material is 20 to 40 inches thick. This soil is better drained and is deeper to lime than is described for the Salmo series because of the overwash material.

Included with the soil in mapping are small areas of Kennebec soils and Nodaway soils. They make up about 5 percent of the map unit.

This Salmo soil has moderately slow permeability. Natural fertility is low, and content of organic matter is moderate. Available water capacity is moderate or high. Runoff is slow. Slightly to strongly saline layers are 10 to 20 inches below the surface. Moisture is not readily available to plants. In places where the plow layer is alkali, the soil is puddled and hard to work. The seasonal high water table ranges from 2 to 3 feet below the surface.

Most of the acreage of this soil is in native grass and is used for grazing; however, some areas are cultivated. This soil has fair potential for cultivated crops that are irrigated, grasses, and wildlife habitat. The potential is poor for most engineering uses and for trees planted in windbreaks.

This soil is poorly suited to irrigated corn, grain sorghum, and tame grasses. The content of soluble salt in the irrigation water needs to be tested before an irrigation system is developed. Low spots that hold water for a short time add to the problems of wetness and salinity. If this soil is leveled, surface drainage is improved. Open drains or tile drains are needed in some areas. Use of crop residue and applications of large amounts of barnyard manure improve tilth and water intake. Corn or sorghum should not be cut for silage because the crop residue is needed to maintain the content of organic matter. The addition of gypsum helps neutralize the salt and alkali in the soil; the amount of gypsum needed should be determined by soil tests. If amounts of water are added to soil that has adequate surface drainage, the salts tend to be leached to a lower level and productivity is increased.

This soil is suited to such desirable grasses as western wheatgrass, slender wheatgrass, and switchgrass. Less desirable inland saltgrass invades overgrazed pasture or range. The range condition can be maintained or improved by a planned grazing system. Distribution of livestock can be improved by proper placement of fences and salting facilities.

The saline or alkali condition of the soil is the principal hazard to trees planted for windbreaks. Replacing toxic sodium and leaching of soluble salts improve the chances of survival and growth of adapted species.

This soil is commonly near creeks, intermittent lakes, or marshes. The vegetation that grows on this soil provides food for waterfowl.

This soil is generally not suitable for building sites because of the hazard of flooding. It is generally not suited to septic tank absorption fields and sewage lagoons because of moderately slow permeability, flooding, and wetness. Roads that cross these areas need to be elevated with fill to prevent damage from flooding. This saline-alkali soil is poor material for topdressing an area where vegetation is to be established and maintained. The water table is a hazard in deep excavations. Because this soil is highly corrosive to steel, coating of buried pipes is needed. Concrete also is highly susceptible to corrosion.

This soil is in capability unit IVs-1 dryland and IVs-4 irrigated. It is in Saline Lowland range site and windbreak suitability group 8.

Sb—Salmo silty clay loam, channeled, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands that are frequently flooded. Shallow depressions and meandering drains are common. Areas are long and range from 3 to 100 acres.

Typically, the surface layer is friable silty clay loam about 15 inches thick. The upper part is black, the middle part is very dark gray, and the lower part is black. The next layer is very dark gray, friable silty clay loam about 9 inches thick. The underlying material, to a depth of 60 inches, is silty clay loam. The upper part is very dark grayish brown with dark yellowish brown mottles and the lower part is dark gray with yellowish brown mottles. This soil is calcareous at the surface; however, in a few places lime is at a depth of more than 10 inches. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of Lamo soil and Zook soil. In places, intermittent lakes and marshes are in shallow depressions. The included soils make up about 5 percent of the map unit.

Permeability is moderately slow in this Salmo soil, and runoff is slow. Natural fertility is low, and content of organic matter is moderate. Available water capacity is moderate or high. Moisture is readily available to plants unless the soil is drained. The seasonal high water table is at or above the surface to as much as 2.5 feet below the surface. Reaction of the surface layer is mildly alkaline. This soil is slightly or moderately affected with salinity and is affected with sodium in most places.

Most of the acreage of this soil is in native grass and is used for grazing. The soil has poor potential for cultivated crops, tree windbreaks, and for most engineering uses. The potential is good for grasses and wildlife habitat.

Unless flooding is controlled, artificial drainage is provided, and the land is leveled, this soil is generally not suited to cultivated crops. Tile drains can improve internal drainage if outlets are available. It is difficult to leach the excess salt from the soil for dryfarming. The addition of gypsum to the soil helps to neutralize the salts and alkali. The amount of gypsum needed should be determined by soil tests.

Prairie cordgrass is the most common grass. If the area is overgrazed, the range is invaded by inland saltgrass. Reed canarygrass and tall wheatgrass are introduced cool-season species that grow well on this soil. Range condition can be maintained or improved by a planned grazing system. Vegetation should be grazed before it becomes woody and unpalatable.

This soil generally has poor sites for planting tree windbreaks; however, chances of survival and growth of adapted species are fair. Use of machinery for planting in spring is generally restricted because the soil is commonly too wet.

Improving the growth of vegetation adds to the amount of food and cover available for wildlife. Muskrat, beaver, and other furbearers inhabit the intermittent ponds and swamps. Waterfowl also use these areas. This soil has poor sites for camping and picnicking.

This soil has severe limitations for building sites, sewage lagoons, septic tank absorption fields, and roads because of moderately slow permeability, the hazard of flooding, and wetness. Artificial drainage and elevated roadbeds are needed in road construction.

This soil is in capability unit Vw-7 dryland. It is in Saline Subirrigated range site and windbreak suitability group 6.

Sc—Salmo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands. It is occasionally flooded. Areas are irregular in shape and range from 3 to 150 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 24 inches thick. The underlying material is silty clay loam. The upper part is dark grayish brown and the lower part, to a depth of 60 inches, is gray. Yellowish brown mottles are common. This soil is generally calcareous in the surface layer. In some areas, lime is 10 inches below the surface.

Included with this soil in mapping are small areas of Lamo soils. These areas make up less than 5 percent of the map unit.

Permeability is moderately slow in this Salmo soil, and runoff is slow. Reaction ranges from mildly alkaline to strongly alkaline. This soil is slightly saline or moderately saline. Available water capacity is moderate or high, and moisture is released to plants slowly. Natural fertility is low, and content of organic matter is moderate. Shrink-swell potential is high. The seasonal high water table ranges from at or near the surface to 2.5 feet below the surface.

Most of the acreage of this soil is in native grass and is used for grazing; however, some areas are cultivated or have been used for building sites. This soil has poor potential for cultivated crops. It has good potential for grasses and wildlife habitat. The potential is poor for tree windbreaks and for most engineering uses.

This soil is poorly suited to corn. Winter wheat and alfalfa are grown, but flooding early in spring is a hazard. The construction of terraces, diversion ditches, and grassed waterways on adjacent soils at higher elevation reduces runoff and helps to lessen flood damage on this soil. Plant nutrients need to be balanced for the production of crops. Phosphorus is commonly unavailable, and sodium can be taken into the plant in toxic quantities. Adding gypsum to the soil helps to neutralize the salts and alkali. The amount of gypsum needed should be determined by soil tests. Leaching excess salt from the soil for dryfarming is generally difficult. Returning crop residue and applying barnyard manure improve the tilth and increase the water intake of this soil. Where outlets are available, open drains or tile drains can provide drainage and help lower the water table. Without proper drainage, the soil is commonly too wet for cultivation in spring, and wetness causes the soil to warm slowly. The content of soluble salt in irrigation water needs to be analyzed before an irrigation system is developed. If the soil is irrigated, land leveling improves the distribution and surface drainage of the water.

Tall wheatgrass grows well on this soil. Less productive plants, for example, inland saltgrass, Kentucky bluegrass, and annuals, invade the range if it is overgrazed. The range condition can be maintained or improved by a planned grazing system.

Because this soil is commonly near creeks, intermittent lakes, and marshes, vegetation on the soil supplies food for waterfowl. Habitat for rangeland wildlife is fair, but it is very poor for openland wildlife.

This soil provides poor sites for tree plantings. The saline or alkali condition of the soil and the shallow water table limit tree growth and the chances of survival.

This soil is generally not suitable for building sites because of the flooding hazard and seasonal high water table. Soil wetness due to the water table, flooding, and moderately slow permeability limit the use of this soil for septic tank absorption fields or sewage lagoons. Because this soil is highly corrosive to steel, buried pipes need to be coated. Local roads should be elevated to offset wetness and flooding. Ponds can be excavated in the wetter parts of this map unit. Embankments need to be built around the pond to prevent damage from flooding.

This soil is in capability unit IVw-1 dryland and IVw-3 irrigated. It is in Saline Subirrigated range site and windbreak suitability group 8.

ShC—Sharpsburg silty clay loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on upland ridges and side slopes. Most areas are along hilltops throughout the northern half of the county. Areas range from 5 to 600 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, firm silty clay loam; the middle part is brown, firm silty clay; and the lower part is yellowish brown, firm or friable silty clay loam (fig. 10). The underlying material, to a depth of 60 inches, is light yellowish brown silty clay loam.

Included with this soil in mapping are small areas of Mayberry, Pawnee, and Wymore soils which have more clay in the subsoil than Sharpsburg soil. The Mayberry soils and Pawnee soils are near drainageways on upper side slopes and make up 5 to 10 percent of the map unit in some areas. Wymore soils are on lower side slopes and make up 5 to 20 percent of the map unit in some areas. The percentage of included Wymore soils is less in the northeastern part than in the rest of the county.

This Sharpsburg soil has moderately slow permeability and high available water capacity. Runoff is medium. Tilth is generally good, and the soil is easily tilled through a fairly wide range of moisture content. If proper-

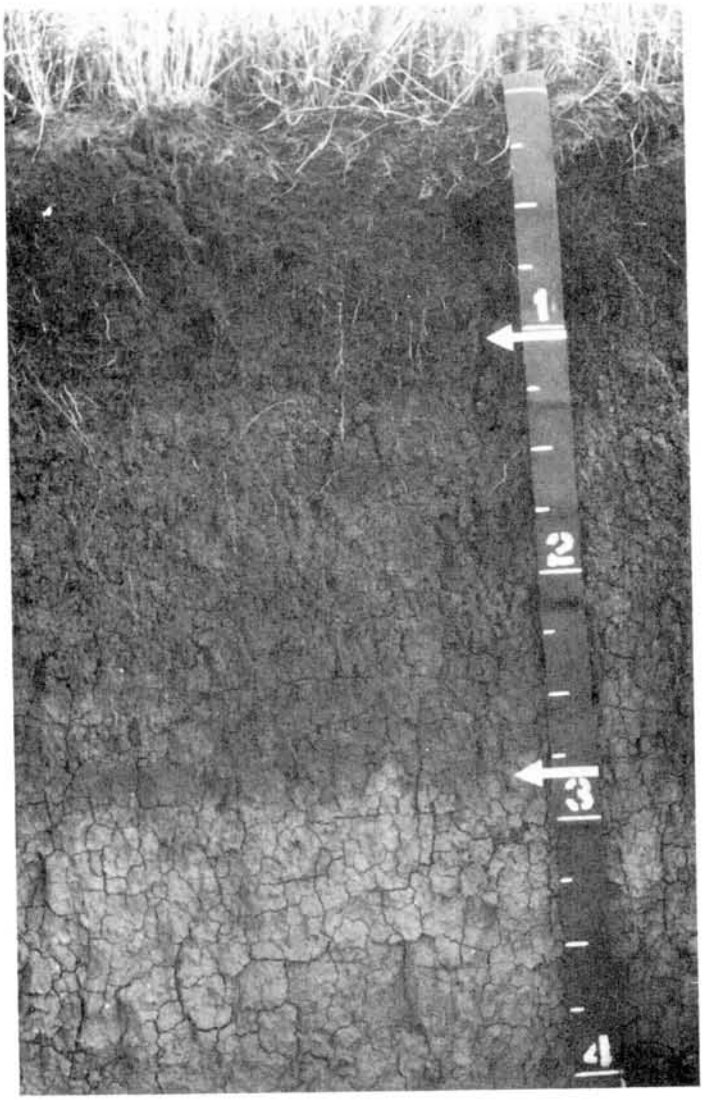


Figure 10.—Profile of Sharpsburg silty clay loam, 2 to 5 percent slopes, that formed in Peorian Loess. Prismatic structure is evident between depths of 12 and 34 inches. The soil is dry below a depth of about 34 inches.

ly managed, this soil retains water and nutrients well and releases moisture readily to plants. Natural fertility is high, and content of organic matter is moderate. Content of available phosphorus is low or very low in the middle part of the subsoil where the content of clay is highest. It is generally low or medium in other parts of the soil profile below the plow layer. Reaction of the surface layer ranges from strongly acid to slightly acid. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. The rest is used for farmsteads. This soil has good potential for cultivated crops, grasses, and trees for windbreaks. Potential is also good for wildlife habitat and for recreation uses. It is fair for most engineering uses.

This soil is suited to corn, sorghum, wheat, soybeans, and alfalfa. Control of water erosion is the main concern in management. Other concerns are conserving moisture and maintaining good tilth, high fertility, and content of organic matter. Terracing, constructing grassed waterways, and farming on the contour help to control runoff and erosion. Establishing a good cropping system, managing residue, and applying fertilizer are essential to help control runoff, conserve moisture, and maintain fertility, soil structure, and good tilth. Grassed borders along roadways and turnrows help to control weeds and erosion. Growing crops in sequence reduces plant disease and insect carryovers. Corn and sorghum respond well to applications of nitrogen, phosphorus, and fertilizer; however, the response to potassium fertilizer is generally small. Application of lime is needed in many places. Sprinkler irrigation is preferable to other irrigation systems. Furrow and border irrigation can be used if land is leveled to the extent that water erosion and runoff are kept to a minimum. Erosion due to natural rainfall and applications of additional irrigation water is difficult to control because of slope. Water needs to be carefully controlled so that the application rate is not higher than the intake rate of the soil. Contour bench leveling can be used on most gentle slopes of this soil.

Bromegrass is most commonly used in tame grass pasture. Orchardgrass, tall fescue, and reed canarygrass also grow well. A legume, for example, alfalfa or birdsfoot trefoil, is desirable in the planting system; however, bloat in livestock is a hazard. Tame pasture should be grazed late in spring and in fall, after the grass has reached a height of 5 or 6 inches. Grazing too early in spring or too late in fall weakens the plants. Sufficient leaf growth is needed to develop healthy plants and to store food for the next season. Weeds can be controlled by the use of chemicals. Grasses generally need additional nitrogen. If a legume is included among the pasture grasses, phosphate fertilizer may be needed. Forage production can often be doubled if the soil is irrigated.

Very few areas of this soil are in native grass. Range seeding can be desirable on small tracts where permanent cover is needed. No care other than management of grazing is needed to maintain the forage composition.

This soil generally provides good sites for tree windbreaks. Chances of survival are good, and good growth of adapted species can be expected. Drought and moisture competition from weeds and grasses are the principal hazards. Weeds can be killed by cultivation or by chemicals. Trees need to be protected from livestock and fire, and young trees need protection from rabbits. Because this soil is generally at higher elevation than adjacent soils and native trees are sparse, windbreaks are needed to provide protection for homesites and livestock. Windbreaks slow windspeed and control the drifting of snow. Shrubs included in windbreaks supply food and cover for wildlife.

Residue from grain sorghum and corn left on the ground after harvest are excellent food for pheasants, and wheat and grassed areas provide nesting places. Tree windbreaks are useful as habitat for squirrels, deer, cottontail rabbits, and other mammals. Such birds as quail and mourning dove also use the tree windbreaks.

This soil has moderate limitations for most recreation uses. After rainfall, the clayey soil dries slowly and becomes muddy. A good stand of grass improves conditions for picnic and playground sites. Trees suitable for use in windbreaks can be planted for shade.

This soil is suitable for building sites (fig. 11); however, shrinking and swelling of the soil can damage foundations and basement walls. The proper design of structures helps to reduce this limitation. Slow permeability limits septic tank absorption fields. Enlarging the size of the absorption field commonly overcomes this limitation. This soil is limited for sewage lagoon sites unless slope is modified. Wetness is generally not a problem; however, seepage into basements can occur during periods of heavy rainfall. Wetness tends to increase on the lower slopes and in areas near glacial soils, for example, the Pawnee, Mayberry, or Burchard soils. Roads need to be elevated to permit drainage.

This soil is in capability units IIe-1 dryland and IIIe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

ShD—Sharpsburg silty clay loam, 5 to 9 percent slopes. This deep, strongly sloping, moderately well drained soil is on side slopes. Areas are irregular in shape and range from 3 to 600 acres. About 20 percent of the map unit is slightly eroded.

Typically, the surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsoil is dark brown, friable silty clay loam about 29 inches thick. The underlying material, to a depth of 60 inches, is dark yellowish brown silty clay loam that has grayish brown mottles. In places, the upper part of the subsoil is silty clay. In a few areas, the underlying material contains a few lime concretions.

Included with this soil in mapping are small areas of Wymore, Pawnee, Morrill, Judson, Nodaway, and Colo

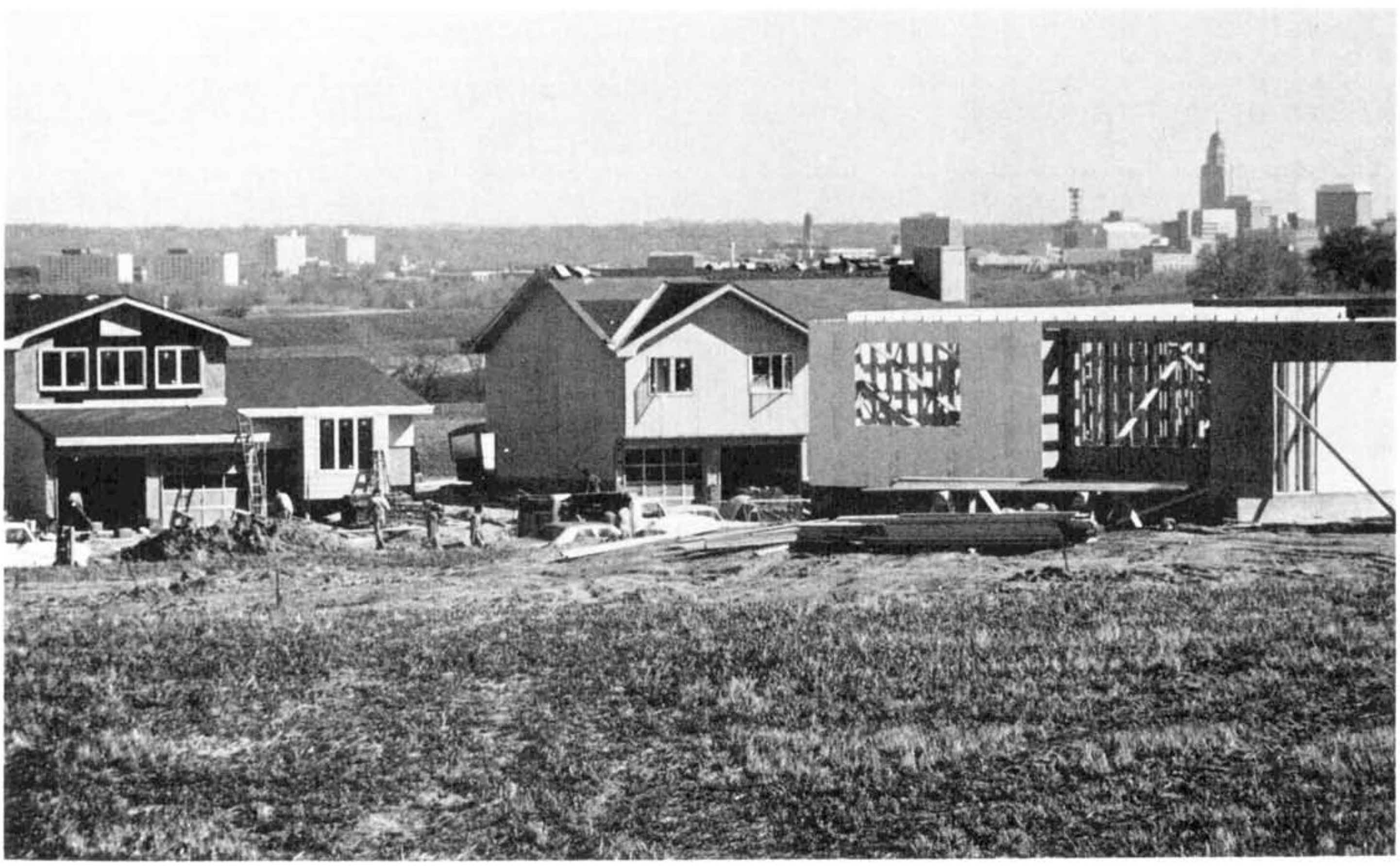


Figure 11.—Urban development near Lincoln in an area of Sharpsburg silty clay loam. The State Capitol is in the background.

soils. Wymore soils are the most extensive of the included soils. They are near drainageways on lower side slopes and have more clay in the subsoil than Sharpsburg soils. Pawnee soils and Morrill soils are generally on steeper parts of the side slopes. They formed in glacial material. Nodaway soils and Colo soils are on bottom lands, and Judson soils are on foot slopes. The included soils make up 10 to 20 percent of the map unit.

This Sharpsburg soil has moderately slow permeability and high available water capacity. Runoff is medium. Content of organic matter is moderate, and natural fertility is high. This soil is easy to till, and moisture is readily available to plants. Reaction of the surface layer ranges from strongly acid to slightly acid. Shrink-swell potential is high.

Most areas of this soil are cultivated. The soil has good potential for cultivated crops, grass, and trees. It has good potential for wildlife habitat and fair potential for most engineering uses.

This soil is well suited to corn, sorghum, small grain, soybeans, and alfalfa. The cropping system should limit the years of consecutive row crops and include such close growing crops as small grain and alfalfa to help control erosion and conserve water. Under intensive management, more years of row crops can be included in the cropping system. Controlling water erosion is the main concern of managment. Terraces, grassed waterways, and the use of crop residue help to control erosion. Sprinkler irrigation can be used. However, it is difficult to control erosion during natural rainfall and applications of additional irrigation water because of slope. Water needs to be carefully controlled so that the application rate does not exceed the intake rate of the soil.

This soil is well suited to grass. However, because most areas of this soil are intensively farmed, very little acreage is in tame pasture or range. Introduced grasses, for example, bromegrass, can be used in the crop rotation. Range consisting of native grasses can be grazed in July and August when tame grasses are semidormant.

This soil generally provides good sites for tree windbreaks. Chances of survival and growth of adapted species are good. Erosion, drought, and competition from weeds and grasses are the principal hazards. Planting trees on the contour reduces the hazard of erosion.

Cultivated crops and grassed waterways supply food and cover for pheasants. Shrubs and trees that grow along the drainageways provide habitat for quail, rabbits, doves, and deer. In places, shallow ponds are along the drainageways. These shallow ponds are not suitable for stocking with fish, but they provide water for wildlife.

Seepage spots occur where the soil overlies glacial till. Water perched on the till is a hazard for buildings with basements. Artificial drainage, footing drains, and basement sump pumps can reduce or overcome seepage. Drainage outlets are generally available. Foundations and basement walls should be designed to withstand the shrinking and swelling of the soil. The surface layer of the soil should be stockpiled and respread over the lawn area when construction and land shaping are completed. Exposed subsoil and underlying material are lower in content of organic matter and fertility than the surface layer. This soil has severe limitations for septic tank absorption fields because of slow permeability. Onsite percolation tests need to be made before a system is installed. The soil is not suited to sewage lagoons unless slope is modified. Roads should be placed on the contour to reduce the hazard of erosion.

This soil is in capability unit IIIe-1 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

ShD2—Sharpsburg silty clay loam, 5 to 9 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on side slopes. Areas are irregular in shape and range from 3 to 400 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is friable silty clay loam about 23 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The underlying material, to a depth of 60 inches, is light yellowish brown silty clay loam. In places, it is grayish brown. In a few areas, the underlying material contains a few lime concretions.

Included with this soil in mapping are small areas of Wymore, Pawnee, Morrill, Judson, Nodaway, or Colo soils. Wymore soils are most extensive. They are near drainageways on lower side slopes and have more clay in the subsoil than Sharpsburg soils. Pawnee soils and Morrill soils are generally on steeper parts of the side slopes. They formed in glacial material. These soils are generally moderately or severely eroded and have a clayey surface layer that is difficult to work. Judson soils are on foot slopes, and Nodaway soils and Colo soils are on narrow bottom lands. The included soils make up 10 to 20 percent of the map unit.

This Sharpsburg soil has moderately slow permeability and high available water capacity. Runoff is rapid. Content of organic matter is moderately low, and natural fertility is medium. Available nitrogen is generally low. The soil takes in water readily and releases it readily to plants. This soil is moderately easy to till. Reaction of the surface layer is medium acid or slightly acid. Shrink-swell potential is high.

Most areas of this soil are cultivated. The soil has good potential for cultivated crops, grass, and trees. It has good potential for wildlife habitat and fair potential for most engineering uses.

This soil is suited to all crops commonly grown in the county. Grain sorghum and wheat are the chief crops. Corn, alfalfa, oats, and soybeans are also grown. A cropping system that limits the years of consecutive row crops and that includes such close growing crops as small grain and alfalfa helps to control erosion and conserve water. Unless properly managed, this soil is subject to further erosion. Controlling runoff and erosion and improving and maintaining fertility and content of organic

matter are the main management needs. Terracing, constructing grassed waterways, and contouring help to control runoff and erosion. Use of crop residue and applications of fertilizer help to control runoff, conserve moisture, and maintain fertility, soil structure, and good tilth. Green manure crops and barnyard manure can be used to improve the content of organic matter and the fertility of this soil. If intensive management is practiced, more years of row crops can be included in the cropping sequence. This soil is suited to sprinkler irrigation, but careful water control is needed because of the severe hazard of erosion. Erosion is difficult to control. Applications of fertilizer are needed for efficient crop growth and to produce sufficient residue for soil protection.

Tame grass pasture or native grass range establishes permanent cover and reduces the hazard of erosion. If bromegrass or a mixture of bromegrass and alfalfa is irrigated, the forage production is increased. Rill erosion is a hazard on grassland that is overgrazed.

Adapted species of trees have a good chance for survival and growth if they are not subjected to drought or if the competition from weeds and grasses for available moisture is not excessive. Planting trees on the contour reduces the hazard of erosion.

Cultivated fields are generally large; however, waterways, grassed borders around fields, and road ditches provide cover for upland wildlife. Sorghum and corn are excellent food for pheasants and quail. This soil is suited to the construction of small dams. Tree windbreaks provide habitat for many kinds of wildlife, and this habitat can be further improved if shrubs are planted in the windbreaks.

This soil is limited for the construction of buildings because of slope and the shrink-swell characteristic. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Where water perches on the underlying glacial till, footing drains and basement sump pumps can be used to reduce or overcome seepage. Some land shaping may be needed. However, this soil is erodible, and steep banks should be sloped and seeded to reduce erosion. Roads and buildings should be constructed on the contour to lessen the need for deep cuts. Bare surfaces need to be revegetated as soon as possible. Septic tank absorption fields in this soil should be placed in the underlying soil material for best performance. A soil percolation test should be made before a septic tank system is installed. Areas near or on the included Wymore or Pawnee soils have slow permeability which can cause effluent to rise to the surface. Slope is commonly too steep for sewage lagoons.

This soil is in capability units IIIe-8 dryland and IVe-3 irrigated.

ShE2—Sharpsburg silty clay loam, 9 to 15 percent slopes, eroded. This deep, moderately steep, moderately well drained soil is on side slopes of the loess uplands. This soil is generally lighter colored in the surface layer than adjacent soils. Areas are irregular in shape and range from 3 to 75 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is dark grayish brown, firm silty clay loam and the lower part is grayish brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is silty clay loam. The upper part is grayish brown and the lower part is light brownish gray. The lower part of the subsoil and upper part of the underlying material have yellowish brown mottles. In places, the lower part of the subsoil is exposed at the surface.

Included with this soil in mapping are small areas of Morrill soils and Steinauer soils on lower side slopes that formed in glacial till and Nodaway soils or Colo soils on bottom lands of drainageways that cross these soil areas. Also included are Judson soils on foot slopes. The Morrill soils and Steinauer soils make up less than 10 percent of the map unit in a few areas, and the Judson, Nodaway, and Colo soils make up less than 5 percent of the map unit in most areas.

This Sharpsburg soil has moderately slow permeability and high available water capacity. Runoff is rapid. Content of organic matter is moderately low, and natural fertility is medium. Available nitrogen is generally low. Moisture is readily available to plants. The soil is easy to work. Reaction of the surface layer is medium acid or slightly acid. Shrink-swell potential is high.

Most areas of this soil are used for cultivated crops and make up a small part of larger fields that have less sloping soils. A few areas are in native grass. The soil has fair potential for cultivated crops and good potential for grass, trees, and habitat for openland wildlife. The potential is fair to poor for most engineering uses.

This soil is better suited to such close growing crops as wheat and alfalfa than to other crops. Although a few row crops can be included with close growing crops, row crops should be limited in the cropping system. Water erosion is a severe hazard. Most drainageways need to be planted to grasses to stabilize the water channel. Terracing, contouring, and managing crop residue help to control erosion. Grassed field borders help to control weeds along turnrows and roadways. This soil is poorly suited to irrigation.

Tame grass pasture can be included in the cropping system to help protect the soil from water erosion; however, gully and rill erosion can be hazards in an overgrazed pasture.

This soil can be seeded to native grasses to provide permanent cover on this marginal farmland. The proper distribution of livestock in the range or pasture is improved if fences, livestock water developments, and salting facilities are properly placed. Overgrazing depletes the more desirable grasses, and bluegrass and other less productive grasses and weeds become a considerable part of the vegetative cover.

This soil provides good sites for tree windbreaks, but erosion is a hazard. Chances of survival and growth of

adapted trees are good. Windbreaks should be planted on the contour.

Residue from grain crops is excellent food for pheasants and other wildlife. Few windbreaks are planted on this soil; however, shrubs and trees in drainageways near this soil provide food and cover for deer, quail, birds, squirrels, and cottontail rabbits.

This soil has good sites for small dams, but the ponded area tends to fill with sediment from slopes unless erosion is controlled. Size of the lot and density of buildings are controlled by the moderately steep topography. Deep unprotected cuts made during land shaping erode and cause siltation downstream unless the soil is properly protected by sloping and seeding. Lawns are difficult to maintain because of steepness of slope and the hazard of erosion. This soil is poorly suited to septic tank absorption fields because of slope. Percolation tests should be made before installation. The soil is not suited to sewage lagoons unless slope is modified. Deep cuts and fills are commonly needed for road construction. Roadbanks need to be sloped and seeded with suitable grass and ditch slopes kept to a minimum grade.

This soil is in capability unit IVe-8 dryland. It is in Silty range site and windbreak suitability group 4.

Sk—Sharpsburg silty clay loam, terrace, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on stream terraces. Areas are irregular in shape and range from 3 to 200 acres.

Typically, the surface layer is friable silty clay loam about 11 inches thick. The upper part is very dark brown and the lower part is very dark gray. The subsoil is firm silty clay loam about 29 inches thick. The upper third is very dark grayish brown and the lower part is brown. The underlying material, to a depth of 60 inches, is silty clay loam. It is brown in the upper part and pale brown in the lower part and contains a few small lime concretions. In places, the underlying material is slightly affected with soluble salts. Stratified alluvial material is between a depth of 10 and 20 feet. In some areas, this soil is on high stream terraces.

Included with this soil in mapping are a few small areas of somewhat poorly drained Butler soils in small depressions. They make up less than 5 percent of map unit.

This Sharpsburg soil has moderately slow permeability and high available water capacity. Runoff is slow. This soil releases moisture readily to plants. The content of organic matter is moderate, and natural fertility is high. The content of available phosphorus is generally high or medium in the surface layer and medium or low in the subsoil and underlying material. Reaction of the surface layer is strongly acid or medium acid. This soil generally has good tilth. Ground water is 6 to 12 feet below the surface in most areas. Shrink-swell potential is moderate to high.

Most of the acreage of this soil is used for cultivated crops. The soil has good potential for cultivated crops, grass, trees, and wildlife habitat. The potential is fair for most engineering uses.

This soil is suited to corn, sorghum, wheat, soybeans, and alfalfa. Established alfalfa stands benefit from ground water in most areas. Maintaining the content of organic matter and keeping fertility high are main concerns in management. This soil can be farmed intensively without risk or damage from erosion. Crops grow well on this soil if the cropping system includes proper management of crop residue. Adequate amounts of fertilizer are needed. Corn and sorghum respond well to additional nitrogen. Available phosphorus may be needed in places. Potassium is generally adequate, or only small amounts are needed. Applications of lime are needed in many places. Plant disease and insects can be controlled by using a cropping system that alternates row crops with small grain and hay and pasture. This soil is suited to gravity and sprinkler irrigation. Some land leveling is generally needed before water can be applied by the gravity system. Areas altered by leveling are likely to require applications of zinc.

This soil is well suited to tame pastures. Bromegrass, orchardgrass, tall fescue, and reed canarygrass grow well. A legume can be included in the grass mixture to increase forage production. Fertilizer should be applied according to soil tests. Deep rooted plants benefit from ground water.

Native range includes warm-season grasses that make grazing available during the summer months. This native vegetation used in combination with cool-season pasture can provide season-long grazing.

This soil has good sites for tree windbreaks. Chances of survival and growth of adapted species are good. Competition from weeds and grasses can be eliminated by cultivating between rows and by hand hoeing or by using suitable herbicides in the tree rows. Trees need to be protected from livestock. Mature trees commonly obtain moisture from ground water.

Residue from grain crops provides food for pheasants and other wildlife. Many species of birds nest in the tree windbreaks. These trees provide habitat for many kinds of wildlife.

This soil provides good building sites; however, foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. During periods of heavy rainfall, wetness can be a hazard. Artificial drainage, footing drains, and basement sump pumps can reduce or overcome soil wetness. Because this soil is slowly permeable, larger than average septic tank absorption fields may be required. This soil is suited to sewage lagoons. Ground water and sloughing are hazards in deep excavations. Buried pipes need to be coated. High or very high corrosivity to uncoated steel pipes occurs in places because of ground water and soluble salts. Bluegrass lawns grow well if the surface layer was not covered with fill or removed during construction. Since this soil tends to dry slowly after precipitation, roads should be elevated and gravelled or paved to provide for surface drainage.

This soil is in capability units I-1 dryland and I-3 irrigated. It is in Silty range site and windbreak suitability group 4.

SmD—Shelby clay loam, 6 to 11 percent slopes. This deep, strongly sloping, moderately well drained soil is on lower side slopes of glacial till uplands. A few pebbles are on the surface in most places. Areas are irregular in shape and range from 3 to 40 acres.

Typically, the surface layer is very dark brown, friable light clay loam about 13 inches thick. The subsoil, to a depth of 60 inches, is friable clay loam. The upper part is very dark grayish brown, and the lower part is brown. In places, the surface layer is loam. On a few eroded areas, the surface layer is 5 to 8 inches thick.

Included with this soil in mapping are small areas of Burchard, Judson, Pawnee, and Steinauer soils. Burchard soils are on the upper part of side slopes and Judson soils are on the lower part of side slopes. The clayey Pawnee soils and the calcareous Steinauer soils are on the upper part of side slopes. These soils make up 5 to 15 percent of the map unit in most places. In a few places, sand and gravel is at the surface.

This Shelby soil has moderately slow permeability and high available water capacity. Runoff is medium. Content of organic matter is moderate, and natural fertility is medium. The content of available phosphorus is low or very low. Reaction in the surface layer is strongly acid or medium acid. Moisture is released readily to plants. This soil is easy to work. Shrink-swell potential is moderate.

About 50 percent of the acreage of this soil is used for cultivated crops. The rest is mainly in native grass range or tame grass pasture. This soil has good potential for cultivated crops, grasses, and trees. The potential is fair for most engineering uses because of slope and the shrink-swell characteristic.

This soil is suited to wheat, corn, sorghum, and alfalfa. Controlling water erosion is the main concern of management. A cropping system that limits the years of consecutive row crops and that includes such close growing crops as small grain and alfalfa helps to control erosion and to conserve water. Terraces, contour farming, grassed waterways, and the use of crop residue as mulch help to reduce runoff and control erosion. Where erosion is not controlled, rills are common. Corn and sorghum respond well to addition of nitrogen. Most crops respond to phosphorus. The need for potassium is small. Most areas need applications of lime, especially if legumes are grown. Sprinkler irrigation is suited to this soil; however, erosion is difficult to control under natural rainfall and applications of irrigation water because of slope. Applications of water should not exceed the intake rate of this soil. Very few areas of this soil are irrigated.

Tame grasses, for example, bromegrass, reed canarygrass, orchardgrass, and tall fescue grow well on the soil. This soil is commonly adjacent to steeper soil areas that are susceptible to erosion. Season-long grazing can be maintained if this soil is planted to cool-season grass and the steeper soils are planted to native grass. If a legume is included in the tame grass pasture, forage production is increased. Fertilizer should be applied according to soil tests.

Because runoff from higher adjacent soils supplies moisture to this native grass, production of forage tends to be a little higher on this soil than on other soils in this range site. Proper grazing use, deferred grazing, and planned grazing systems help to maintain or improve range condition. Distribution of livestock in a pasture can be improved by proper placement of fences, water developments, and salting facilities. Range in poor condition needs to be reseeded to native grass.

This soil provides good sites for trees in windbreaks. Because rainfall is somewhat limited and irregular, control of weeds is needed to prevent competition with the young trees for moisture. Cultivation or chemicals can be used to kill weeds. Trees need to be protected from livestock and fire, and young trees need to be protected from rabbits. Windbreaks should be planted on the contour to reduce the hazard of erosion.

Because of the diversity of vegetation, many kinds of wildlife inhabit these areas. Cultivated crops provide food and cover for pheasants and mourning doves. The trees, grasses, and shrubs that grow in nearby draws and along streams are mostly undisturbed and these wooded areas provide habitat for squirrels, bobwhite quail, cottontail rabbits, and deer. Almost every practice that helps to protect and improve the soil and to conserve moisture also improves the food supply and cover for the wildlife. Practices that encourage wildlife are improving the grasses on rangeland and pastureland, using crop residue, maintaining the grass along the edges of cropland, planting windbreaks of trees, and controlling sedimentation.

This soil provides good sites for small dams along drainageways. Seepage is generally low in the reservoir areas; however, pockets of sand and gravel in the underlying glacial till can be subject to high seepage. Soil erosion needs to be controlled to prevent siltation damage to farm ponds. Foundations and basement walls should be designed to withstand the shrinking and swelling of the soil. Because runoff from higher adjacent soils can be a hazard around buildings, land needs to be shaped to slope away from buildings. If good conservation practices are used upslope, runoff can be reduced. Seepage into basements is a hazard during periods of heavy rainfall, especially where water perches on underlying glacial till. Artificial drainage, footing drains, or basement sump pumps can overcome seepage. Outlets are generally available downslope. Because this soil is slowly permeable, larger than average septic tank absorption fields may be required. Slopes are too steep in most places for sewage lagoons. This soil provides good sites for lawns, trees, and shrubs if the surface layer has not been removed or covered with fill.

This soil has limitations for the construction of roads and streets because of frost action and erodible slopes.

Roadbanks need to be planted to a well adapted grass or grass mixture and ditch slopes kept to a minimum grade. Placing roads on the contour reduces erosion.

This soil is in capability units IIIe-1 dryland and IVe-3 irrigated. It is in Silty range site and windbreak suitability group 4.

SoF—Sogn-Rock outcrop complex, 11 to 30 percent slopes. This complex consists of areas of limestone outcrop and shallow or very shallow, somewhat excessively drained Sogn soil (fig. 12). Areas range from 3 to 100 acres, and contain 45 to 65 percent Sogn soil and 25 to 40 percent Rock outcrop. In places the limestone outcrop consists of vertical escarpments. The Sogn soil and Rock outcrop are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Sogn soil has a surface layer of friable silty clay loam about 9 inches thick. Below this depth is limestone bedrock. This soil is calcareous in all parts of the profile.

Included in this complex in mapping are small areas of Burchard soils and Steinauer soils. These deep soils are on upper parts of side slopes and make up 5 to 15 percent of the map unit.

The Sogn soil has moderate permeability and very low available water capacity. Moisture is released readily to plants; however, roots are restricted by bedrock. The soil has moderately low content of organic matter and medium natural fertility. Reaction is neutral or mildly alkaline in the surface layer. Runoff is rapid on the Sogn soil and very rapid on the Rock outcrop.

Nearly all the acreage of this complex is in native grass and trees. These soils have very poor potential for cultivated crops and trees in windbreaks and poor potential for most engineering uses. They have good potential for wildlife habitat and fair potential for grass.

The soils in this complex are not suited to cultivated crops because of rock outcrops and the severe erosion hazard. It is difficult for plants to become established in the limited amount of available soil. The soil is droughty during periods of little rainfall. Slopes and exposed bedrock severely restrict the use of most machinery. In places, the removal of woody shrubs is desirable so that grass can become the dominant vegetation. Maintenance of adequate grass cover is the principal concern in management of grassland. Controlled grazing is needed so that plants can become firmly established and maintained. Leaving about one-half or more of the vegetation each year at the end of the growing season helps to maintain a healthy stand of grass.

This complex is not suitable for windbreak plantings; however, tolerant species can be hand planted in places. Bur oak and locust are the most common trees. A few American elm, hackberry, and green ash are on lower slopes adjacent to valleys.

This complex supports a variety of wildlife. Deer, bobwhite quail, squirrels, and cottontail rabbits are important

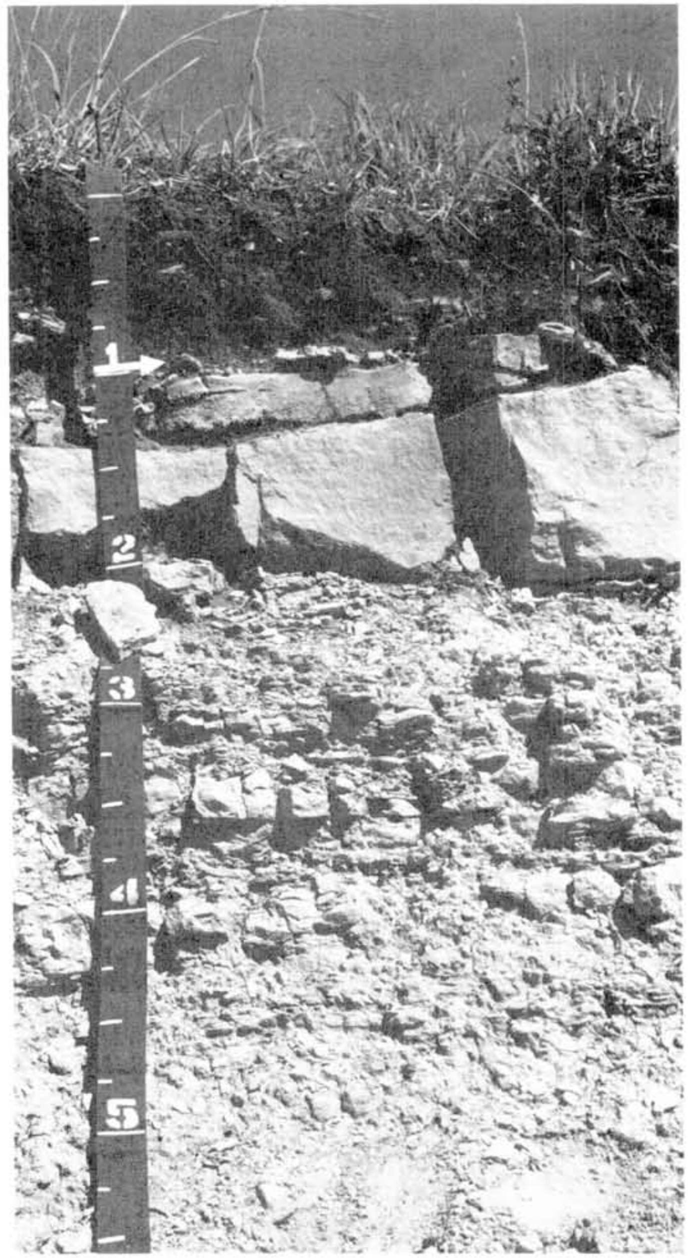


Figure 12.—Profile of Sogn silty clay loam. The soil ranges from 4 to 20 inches thick over limestone bedrock.

game species. Songbirds inhabit areas where herbaceous plants, flowering and fruit trees, shrubs, and vines supply food and cover.

The soils in this complex have limitations for the development of recreation areas because of slope. Some areas provide fine scenic views.

The limestone bedrock in this complex is commonly mined and used to surface roads. The soils provide suitable sites for farm ponds, but seepage is a serious

concern. Careful onsite investigation is needed. Because of steep slopes, deep cuts are needed for the construction of roads. However, digging is difficult because of bedrock, and blasting can be needed to reach the required depth. These soils have severe limitations for buildings and septic tank absorption fields. Coating of buried pipes is needed.

This complex is in capability unit VIs-4. It is in Shallow Limy range site and windbreak suitability group 10.

StD—Steinauer loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on narrow ridgetops and side slopes of glacial till uplands. Few to many stones and pebbles are on the surface. Areas are irregular in shape and range from 3 to 75 acres.

Typically, the surface layer is very dark grayish brown, friable loam less than 6 inches thick. The next layer is dark grayish brown, friable loam about 5 inches thick. The underlying material has many small pockets of soft lime. It is light olive brown loam in the upper part and mixed grayish brown and brownish yellow clay loam in the lower part. This soil is calcareous. The surface layer is clay loam in places.

Included with this soil in mapping are small areas of Burchard soils and Dickinson soils. Burchard soils are on lower side slopes. Dickinson soils are in areas that are generally lower in elevation than Steinauer soils. The included soils make up 5 to 10 percent of the map unit.

This Steinauer soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid, depending on the amount and kind of vegetative cover. Natural fertility is medium, and content of organic matter is moderately low. Reaction is mildly alkaline. The content of available phosphorus is generally low. This soil is easy to work. Water is absorbed and released readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is in native grass. The rest is mainly used for tame grass pasture or cultivated crops. The soil has poor potential for cultivated crops, windbreaks, and wildlife habitat. It has good potential for grass and poor potential for most engineering uses.

This soil is better suited to close growing crops, such as small grain, alfalfa, and grasses, than to other crops. Row crops should be limited in the cropping sequence. Unless terraces are constructed in the areas used for farming, the entire surface layer can be lost in a few years. Row crops should not be cut for silage because the crop residue is needed to control erosion. Applications of commercial fertilizer help to maintain fertility. Phosphorus is especially needed for alfalfa. Because this soil contains an excessive amount of lime, further applications are not needed. This soil is not suitable for irrigation.

Tame grass pasture helps to protect this soil from erosion; however, rills and gullies form in overgrazed areas. A legume included in the grass mixture increases production of forage.

In places, small areas of this soil are adjacent to soils that are poorly suited to tillage. Nearly all of these areas are in native grass and are used as range. If cropland is seeded to improved native grasses, little care other than management of grazing is needed to maintain forage production. Native grass can also be cut for hay.

Erosion, drought, and moisture competition from weeds and grasses are hazards to trees planted in windbreaks. Terracing and planting windbreaks on the contour reduce erosion. Windbreaks need to be fenced to prevent damage from livestock. Trees selected for planting should be able to tolerate the high lime content in the soil.

This soil helps support a variety of wildlife, especially in areas where trees grow along drainageways. Improved range grasses, crop stubble, grass edges of cultivated fields, and trees and shrubs in windbreaks supply food and cover for wildlife.

This soil provides only fair building sites. The adjacent soils are commonly on steeper slopes than this Steinauer soil. Landscaping is difficult where buildings are concentrated. On lots of several acres, single dwellings can be placed on the less sloping parts of the soil. This soil is generally not suited to septic tank absorption fields and sewage lagoons because of moderately slow permeability and slope. Deep cuts can expose areas of seepage. Roadcuts need to be graded to the least incline that is acceptable and seeded to grasses to prevent erosion.

This soil is in capability unit IVe-9 dryland. It is in Limy Upland range site and windbreak suitability group 5.

StF—Steinauer loam, 11 to 30 percent slopes. This deep, moderately steep or steep, somewhat excessively drained soil is on very narrow ridgetops and side slopes of glacial till uplands. A few pebbles and stones are on the surface. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is friable, very dark grayish brown loam about 5 inches thick. The next layer, about 7 inches thick, is friable, brown loam. The upper part of the underlying material is yellowish brown loam and the lower part is light olive brown clay loam. This soil is generally calcareous. In a few areas, the surface layer is clay loam.

Included with this soil in mapping are small areas of Dickinson, Malcolm, and Shelby soils. These soils are in areas that are generally lower in elevation than Steinauer soil. Also included are small areas of Burchard clay loam. The included soils make up 5 to 15 percent of the map unit in places.

This soil has moderately slow permeability. Runoff is rapid. Available water capacity is high, and content of organic matter is moderately low. Natural fertility is medium. The reaction of the surface layer is neutral or mildly alkaline. Moisture is released readily to plants. Shrink-swell potential is moderate.

Almost all of the acreage of this Steinauer soil is in native grass and is used as range. A few areas are used for hay. This soil has poor potential for cultivated crops

and for most engineering uses. It has good potential for grass and fair potential for wildlife habitat. The potential is very poor for tree windbreaks.

This soil is subject to severe erosion if the vegetation is removed. It is not suitable for cultivation because of moderately steep and steep slopes.

Maintaining a good cover of native grass is the principal concern of management. Controlled grazing that leaves one-half of the vegetation for the following year enables the grass to store nutrients in the root system and insures a healthy stand of range grasses. Proper stocking, deferred grazing, and rotation grazing are needed to maintain the proper kind and amount of grass. On overgrazed rangeland, the soil erodes and gullies readily form natural drainageways. Care should be taken when mowing grass for hay on steep slopes.

This soil is generally not suited to trees in windbreaks. However, chances for survival are fair for plantings in a few areas where the slopes are less than 15 percent. Trees and shrubs for wildlife habitat can be planted by hand. Trees that tolerate a high content of lime in soils should be selected for planting.

This soil helps support a variety of wildlife. Deer are plentiful in areas of trees along nearby drainageways. Cottontail rabbits are also plentiful.

This soil is poorly suited to septic tanks and sewage lagoons because of moderately slow permeability and steep slopes. These limitations should be taken into account in designing structures. Although the area provides a scenic view, this soil is poorly suited to building sites. Landscaping is difficult because of the steep slopes, and lawns are difficult to maintain. Deep cuts sometimes expose areas of seepage. Roadcuts need to be graded to a slope that will support a vigorous growth of grass.

This soil is in capability unit VIe-9 dryland. It is in Limy Upland range site and windbreak suitability group 10.

SuD2—Steinauer clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well-drained soil is on narrow ridgetops and side slopes of glacial till uplands. Pebbles are on the surface in places. Areas are irregular in shape and range from 4 to 100 acres.

Typically, the surface layer is friable clay loam about 6 inches thick. It is dominantly very dark grayish brown mixed with yellowish brown underlying material. The underlying material, to a depth of 60 inches, is clay loam. The upper part is brown, the middle part is light brownish gray, and the lower part is pale brown with yellowish brown mottles. This soil is calcareous. In places where erosion has entirely removed the original surface layer, the plow layer is grayish brown or brown.

Included with this soil in mapping are small areas of Burchard soils on the lower half of side slopes.

This Steinauer soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetation. The soil has low natural fertility and content of organic matter. Reaction is mildly alkaline or moderately alkaline in the surface layer. The content of available nitrogen and phosphorus is low. Moisture is released readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is used for cultivated crops or tame grass pasture. Some areas have been reseeded to native grass. This soil has fair potential for cultivated crops, windbreaks, and wildlife habitat. It has good potential for grass and poor potential for most engineering uses.

This soil is better suited to close growing crops, for example, wheat, alfalfa, and grasses, than to other crops. Controlling water erosion and siltation downstream are the main concerns of management. Terracing, contouring, and managing crop residue help to control erosion and downstream siltation. Gullies can be filled in or shaped and seeded to grass. Fertility and the content of organic matter need to be increased. Applications of barnyard manure and commercial fertilizer improve and maintain fertility. Because this soil contains an excessive amount of lime, further applications are not needed. This soil is not suited to irrigated crops.

The use of tame grass pasture in the crop rotation is an effective way to control erosion. Bromegrass, an introduced cool-season grass, is the most commonly used grass on this soil. If such grasses as orchardgrass and such legumes as alfalfa and birdsfoot trefoil are added to the bromegrass, the pasture has more potential and produces more consistently than if the pasture consists of a single species. If intensive management and a suitable cropping system are not used, this soil should be reseeded to native grass and used as range or native hayland.

After seeding, little care other than management of grazing is needed to maintain forage production. Planned grazing systems maintain or improve the condition of range. Distribution of livestock can be improved by the correct placement of fences and watering and salting facilities.

Trees planted on this soil have a fair chance of survival but grow poorly. Lack of adequate moisture and moisture competition from weeds and grasses are the principal hazards. Erosion is a hazard if cultivation is used to control weeds. Windbreaks should include species that tolerate a high content of lime in soil.

This soil is generally near soils that support such diverse vegetation as trees, native grasses, and grain sorghum. This vegetation provides habitat for pheasants, cottontail rabbits, doves, and deer.

Steepness of slope is a limitation for installation of septic tank absorption fields. Trench lines need to be installed on the contour. This soil is not suited to sewage lagoons unless slope is altered. It has fair suitability for development of building sites on the less sloping areas. Bluegrass lawns and shrubs tend to grow poorly around newly constructed dwellings. Lawn areas need to be topdressed with medium textured soil material that is moderately high in content of organic matter. Founda-

tions and basement walls should be designed to withstand the shrinking and swelling of the soil. This soil is well drained; however, seepage can occur if deep cuts are made into the glacial till. If water-bearing seams are encountered, footing drains may need to be installed. Placing roads on the contour reduces the hazard of erosion.

This soil is in capability unit IVe-9 dryland. It is in Limy Upland range site and windbreak suitability group 5.

SuG—Steinauer clay loam, 20 to 40 percent slopes. This deep, steep and very steep, excessively drained soil is on side slopes of uplands. Slipping of the soil has formed vertical steps, commonly called catsteps. Vertical walls along the active gullies are barren. Areas are long and range from 5 to 300 acres.

Typically, the surface layer is very dark grayish brown, friable clay loam about 4 inches thick. The next layer is brown, firm clay loam 4 inches thick. The underlying material is firm clay loam to a depth of 60 inches. The upper part is olive brown with strong brown and olive gray mottles. The lower part is light olive brown with olive gray mottles. This soil is calcareous; however, some weakly developed soils are noncalcareous. Some areas are mantled with noncalcareous loess.

Included with this soil in mapping are small areas of Dickinson soils and Shelby soils on side slopes. Also included are areas of Nodaway soils along narrow drainageways. These soils make up 10 to 15 percent of the map unit.

This Steinauer soil has moderately slow permeability and high available water capacity. Runoff is very rapid. Content of organic matter is moderately low, and natural fertility is medium. Moisture is released readily to plants. Shrink-swell potential is moderate.

All areas of this soil are in native grass or a mixture of native grass and trees. The soil has poor potential for cultivated crops and for most engineering uses. Potential is fair for range and good for wildlife habitat. The potential is very poor for tree windbreaks.

This soil is too steep for tillage with farm machinery. Terraces on cultivated land and controlled grazing on upstream rangeland reduce runoff and lessen gully erosion.

In areas where trees are sparse, the range is in good condition. Livestock mostly graze the less sloping areas which are more accessible. In wooded areas, the tree canopy limits sunlight needed for growth of the more desirable grasses. Salting and watering facilities should be placed so that livestock do not trail on active gullies.

Planting of tree windbreaks is not practical because of very steep slopes. However, desirable trees and shrubs can be planted by hand. Trees in wooded areas are mostly oak, ash, hackberry, elm, and maple. Buckbrush grows in places.

Where trees are abundant, habitat is very good for deer, squirrels, raccoons, and opossum. On open areas, cottontail rabbits, coyotes, and doves are abundant. In places, streams supply water.

The very steep slopes limit some recreation uses of this soil, for example, playground areas, campsites, and picnic areas. However, the soil provides good areas for hunting and nature studies.

This soil is not suited to building sites, septic tanks, or sewage lagoons because of the very steep slopes. In places, areas overlooking this soil are scenic; however, encroaching gullies can be a hazard to buildings. Good sites for dams are available in places. A large amount of earthmoving is needed for the construction of roads.

This soil is in capability unit VIIe-9. It is in Limy Upland range site and windbreak suitability group 10.

Ua—Udorthents. This map unit consists of soils of the final cover material of an active sanitary landfill area where solid waste is covered daily. It occupies one area in the county. Some areas which are filled with soil and waste material are at a higher elevation than the adjacent soils.

The surface varies from nearly level on some of the filled areas to moderately steep on areas actively being filled. The waste materials are buried at a depth of about 10 feet. Four to five feet of soil material is used for the final cover over the waste material. The site of the area to be filled changes from time to time so that the entire area gradually becomes higher in elevation.

The final soil cover material is thick enough to support plants. It is dark or moderately dark, alkaline or calcareous, silty material that commonly contains some soluble salts. The active part of the area consists of refuse of variable texture, concrete fragments, construction materials, and other waste that is dumped and smoothed out.

This map unit needs onsite investigation to determine use, suitability, and management requirements. It is not placed in a capability unit, range site, or windbreak suitability group.

Uc—Urban land-Crete-Sharpsburg complex, 0 to 2 percent slopes. This complex consists of areas of Urban land and deep, nearly level, moderately well drained Crete and Sharpsburg soils on stream terraces. About 50 percent is Urban land; 15 to 25 percent, Crete soils; and 15 to 20 percent, Sharpsburg soils. Areas range from 15 to 1,000 acres. The Urban land areas, Crete soils, and Sharpsburg soils are so intricately mixed or in such small areas that it is not practical to separate them in mapping.

Urban land consists of streets, parking lots, airport runways, buildings, and other structures. The soil material beneath the Urban land is similar to the material in the Crete and Sharpsburg soils.

Typically, the Crete soil has a surface layer about 13 inches thick. The upper part is very dark brown, friable silt loam, and the lower part is black, friable light silty clay loam. The subsoil is about 31 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is brown, firm silty clay; and the lower part is brown, firm silty clay loam. The underlying material, to a depth of 60 inches, is pale brown silty clay loam.

Typically, the Sharpsburg soil has a surface layer of very dark brown, friable light silty clay loam about 14 inches thick. The subsoil is about 34 inches thick. The upper part is dark brown, firm, heavy silty clay loam; the middle part is brown, firm, light silty clay; and the lower part is pale brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is pale brown, light silty clay loam.

Included in mapping and making up 5 to 10 percent of the complex are small areas of Judson, Kennebec, and Butler soils. Judson soils are on colluvial foot slopes, and Kennebec soils are on bottom lands adjacent to drainageways. Butler soils are in slightly concave areas and are somewhat poorly drained.

Permeability is slow in the Crete soil and moderately slow in the Sharpsburg soil. In both soils available water capacity is high, and runoff is slow. Content of organic matter is moderate, and natural fertility is high in both soils. In the areas of Urban land, mixed fertilizer has been used on most lawns, and the content of available phosphorus is generally high or very high in the surface layer. Moisture in the Crete soil is released slowly to plants, and this soil is slightly droughty. Moisture in the Sharpsburg soil, however, is readily available to plants. These soils are easy to work. In areas where the friable surface layer has been removed during construction, the soils are hard to till, and content of organic matter and fertility are low. These soils absorb moisture slowly, and they are droughty. Shrink-swell potential is high in both soils.

The Crete and Sharpsburg soils, which make up the open areas of this complex, are used for open spaces, lawns, or gardens. A few small areas are farmed. These soils have good potential for lawns, vegetable and flower gardens, trees and shrubs, and recreation areas. They have fair potential for most engineering uses.

The soils in this complex are well suited to grass and garden plants if the friable surface layer has not been removed or covered with clayey subsoil during housing construction. Lawns need frequent applications of nitrogen and, in places, iron is needed. Phosphorus may be needed in new lawns. Content of zinc is often low in excavated areas. Weekly irrigation is needed during the dry months in summer. This soil has fair suitability for gardens. Tilth can be maintained by adding such organic matter as manure or compost.

Many trees and shrubs have been planted on these soils. They supply shade along streets and in parks, beautify lawns and homes, provide privacy, and reduce noise. Trees, shrubs, and lawns planted around homes and commercial and public buildings provide habitat for many kinds of wildlife, for example, birds, rabbits, and squirrels.

Because these soils are nearly level, they are suitable for athletic fields and other recreation uses. Some land shaping may be needed on flat areas to improve surface drainage.

Foundations and basement walls should be designed to withstand the shrinking and swelling of these soils. The grounds around buildings should be landscaped to drain surface runoff away from basement walls. Drain spouts are needed to carry the water several feet away from the buildings. Because the soils have high shrink-swell and are susceptible to frost action, occasional street repair is needed. Onsite investigation is essential to properly evaluate and plan the development of specific sites.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

UdB—Urban land-Judson complex, 1 to 3 percent slopes. This complex consists of areas of Urban land and very gently sloping, moderately well drained Judson soils on colluvial foot slopes. The areas are generally bisected by intermittent streams. The natural drainage has often been altered by streets and storm sewers. About 40 to 55 percent of the complex is Urban land, and 25 to 40 percent is Judson soil. Areas range from 15 to 300 acres. The Urban land areas and Judson soil are so intricately mixed, or in such small areas that it is not practical to separate them in mapping.

Urban land consists of streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. The soil material beneath the Urban land is similar to the material in Judson soils.

Typically, the Judson soil has a very dark brown, friable surface layer about 28 inches thick. The upper part is silt loam and the lower part is silty clay loam. The subsoil, to a depth of 60 inches, is silty clay loam. The upper part is dark brown and friable; the middle part is brown and firm; and the lower part is brown and friable.

Included in mapping and making up 5 to 20 percent of the complex are small areas of Nodaway, Wymore, and Pawnee soils. Nodaway soils are on bottom lands adjacent to drainageways. Wymore and Pawnee soils are on lower side slopes at a slightly higher elevation than the colluvial foot slopes.

This Judson soil has moderate permeability. It is subject to runoff from soils at a higher elevation. This soil is easy to work. Moisture is readily available to plants. Natural fertility is high, and content of organic matter is moderate. Reaction is medium acid in the surface layer. Shrink-swell potential is moderate.

The Judson soil, which makes up the open part of the complex, is used for parks, open space, building sites, and gardens. It has good potential for lawns, vegetable and flower gardens, trees, and shrubs. The potential is good for most recreation uses and fair for most engineering uses.

Judson soil is well suited to grasses, flowers, vegetables, trees, and shrubs. More maintenance and applications of fertilizer are required for lawn and garden areas if the original surface layer has been covered with material from excavations. The friable surface layer of Judson soil makes good potting soil around shrubs and trees in areas of clayey soil. This soil provides good sites for tree

plantings. Adapted species survive and grow well. Grassed areas of this soil are more easily maintained than grassed areas of sloping soil.

In a few places, the soils adjacent to streams are left as open areas and the grass, trees, and shrubs that grow there supply cover and food for many kinds of wildlife.

These soils are well suited to playgrounds, picnic areas, athletic fields, and golf courses. Land shaping may be needed for some recreation uses.

Foundations and basement walls need to be designed to withstand the shrinking and swelling of these soils. Wetness is a hazard during periods of heavy rainfall, especially in the drainageways that cross this complex. Artificial drainage, footing drains, and basement sump pumps reduce or overcome wetness. Building sites should be shaped to provide for surface drainage. The included Nodaway soils are poorly suited to building sites because of wetness and flooding. Nearly all sanitary facilities are connected to public sewers and treatment facilities. During construction, siltation from runoff from higher areas can cause damage to streets that are not yet paved. Onsite investigation is essential to properly evaluate and plan development of specific sites for the land use desired.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

Uk—Urban land-Kennebec complex, 0 to 2 percent slopes. This complex consists of areas of Urban land and nearly level, moderately well drained Kennebec soils on bottom lands. The areas are bisected by perennial streams and are occasionally flooded. About 45 percent is Urban land and 40 percent is Kennebec soil. Areas are several hundred acres. The Urban land areas and Kennebec soil are so intricately mixed that it is not practical to separate them in mapping.

Urban land consists of streets, parking lots, airport runways, buildings, and other structures that obscure or alter the soils so that identification is not feasible. The soil material beneath the Urban land is similar to the material in Kennebec soils.

Typically, the Kennebec soil has a surface layer about 43 inches thick. The upper part is black, friable silt loam; the middle part is very dark brown, friable silt loam; and the lower part is very dark grayish brown, friable silty clay loam. The transitional layer, to a depth of 60 inches, is firm silty clay loam.

Included in mapping and making up about 15 percent of the complex are small areas of Judson soils and somewhat poorly drained Colo soils and Zook soils. Judson soils are on colluvial foot slopes. Colo soils and Zook soils are on low lying bottom lands. Sandstone is exposed along stream channels in a few places.

Channel stabilization of the streams that cross this complex has reduced the hazard of flooding (fig. 13). Construction of terraces, dams, and other conservation practices upstream have also helped control flooding. During periods of heavy rainfall, however, flooding is a hazard.

The Kennebec soil has moderate permeability and high available water capacity. Runoff is slow. Content of organic matter is moderate, and natural fertility is high. The seasonal high water table is more than 5 feet below the surface. This soil releases moisture readily to plants. It is easy to work. Reaction of the surface layer is medium acid or slightly acid. Shrink-swell potential is moderate.

Kennebec soil, which makes up the open areas of the complex, is used for parks, open space, airports, building sites, lawns, and gardens. A few areas are farmed or are seeded to bromegrass. This soil has good potential for vegetable and flower gardens, trees, shrubs, and grass. It has poor potential for most engineering uses.

Kennebec soil is one of the best suited soils in the county for grasses, flowers, vegetables, trees, and shrubs. The soil is friable and high in available nutrients. It is good potting soil for trees and shrubs or topdressing for lawns or gardens where the soil is clayey and difficult to work. This soil has good potential for bluegrass sod. In places, trees obtain moisture from the water table. Many trees have been planted in parks, and they also grow naturally along the streams.

The soils in this complex have limitations for picnic areas, golf courses, athletic fields, and playgrounds because of the flooding hazard. However, these recreation areas are easier to mow, irrigate, and landscape than areas of the more sloping uplands. A good cover of grass is easy to maintain. In landscaping, cuts 1 foot to 3 feet deep can generally be made without exposing clayey material. Because soils are commonly muddy in spring, play areas and walkways may require special surfacing.

Wooded and grassed areas supply food and cover for wildlife. Squirrels, rabbits, and many kinds of birds are common. Raccoons and opossums use the wooded areas. Several lakes have been built in these soils.

These soils are poorly suited to homesites because of the flooding hazard. Commercial buildings, however, are commonly constructed on these soils because of their desirable location. Filling and land shaping can lessen the hazard of flooding. Because seepage into basements is a hazard during wet periods, commercial buildings need footing drains and basement pumps, or they should be built without basements. Sanitary facilities should be connected to commercial sewers and treatment facilities. Surfaced areas, for example, streets and parking lots, are subject to frost action and require intensive maintenance. Onsite investigation is essential to properly evaluate and plan development of specific sites.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

UpC—Urban land-Pawnee-Mayberry complex, 2 to 7 percent slopes. This complex consists of areas of Urban land and deep, gently sloping, moderately well

Figure 13.—Channel stabilization has reduced the hazards of erosion and flooding in this area of Urban land-Kennebec complex.

drained Pawnee and Mayberry soils on side slopes. About 50 percent is Urban land, 25 percent Pawnee soils, and 20 percent Mayberry soils. Areas range from 10 to 150 acres. The Urban land areas, Pawnee soils, and Mayberry soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Urban land is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. The soil material beneath the Urban land is similar to the material in the Pawnee and Mayberry soils.

Typically, the Pawnee soil has a surface layer of very dark brown, friable clay loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is dark brown, firm clay; the next layer is brown and dark yellowish brown, firm clay; the next layer is light olive brown, firm clay that has yellowish brown mottles; and the lower part is olive gray, firm clay loam. The underlying material, to a depth of 60 inches, is olive gray clay loam. The underlying material and lower part of the subsoil are calcareous and have strong brown mottles. In a few places, where erosion has been severe or where construction has disturbed the soils, the surface layer is clay. In places, the underlying material has pockets of sand or sand and gravel.

Typically, the Mayberry soil has a surface layer of very dark grayish brown, firm clay loam about 10 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown, firm clay, and the lower part is dark brown, firm clay loam. The underlying material, to a depth of 60 inches, is yellowish brown clay loam. In places, the surface layer is silty clay or silty clay loam.

Included in mapping are small areas of Sharpsburg soils. These soils are in the slightly higher areas. They make up about 5 percent of the map unit.

The Pawnee and Mayberry soils have slow permeability and moderate available water capacity. Content of organic matter is moderate, and natural fertility is medium. These soils absorb and release moisture slowly. Reaction of the surface layer is medium acid. Shrink-swell potential is high.

The Pawnee and Mayberry soils, which make up the open areas of this complex, are used for building sites,

open space, lawns, or gardens. These soils have fair potential for lawns, vegetable and flower gardens, trees and shrubs, and recreation areas. They have poor potential for most engineering uses.

Grass and gardens are easier to maintain in areas where the surface layer has not been removed or covered with clayey subsoil material during landscaping. The original dark surface layer is less droughty and is easier to till. Fertility can be maintained and tilth in gardens can be improved if organic matter such as manure or compost is added. Fall plowing and keeping traffic to a minimum help to maintain tilth. Dark, friable soil can be used as potting soil around trees and shrubs to help plants become established. Bluegrass lawns need several applications of nitrogen during the growing season. Vegetable gardens can require phosphorus and nitrogen. Soil erosion is a serious hazard in this complex if the soils are disturbed and are left bare and exposed for a considerable period of time. These soils can be protected from soil blowing and water erosion by planting adapted grasses.

Foundations and basement walls should be designed to withstand the shrinking and swelling of the soils in this complex. Replacing the abutting soil material with material of lower clay content and lower shrink-swell properties is desirable. Seepage is a problem in many places during rainy periods. Artificial drainage, footing drains, and basement sump pumps help to reduce or overcome wetness. All sanitary facilities should be connected to public sewers and treatment facilities.

Pawnee and Mayberry soils are highly susceptible to frost action and shrink-swell. Road base needs to be designed to reduce the effects of frost action. In places, replacement or modification of the road base may be needed to overcome the limitation of shrink-swell.

These soils have moderate limitations for picnic areas and playgrounds. The surface dries slowly in spring when precipitation is heavy. Well maintained grass reduces the muddy condition. Play areas and walkways can require special surfacing. Onsite investigation is essential to properly evaluate and plan the development of specific sites.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

Uw—Urban land-Wymore complex, 0 to 2 percent slopes. This complex consists of Urban land and deep, nearly level, moderately well drained Wymore soils on upland ridges. About 55 percent is Urban land and 35 percent is Wymore soils. Areas range from 80 to 200 acres. The Urban land areas and Wymore soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Urban land is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. The soil material beneath the Urban land is similar to the material in the Wymore soils.

Typically, the Wymore soil has a surface layer of very dark gray, friable silty clay loam. The subsoil is about 36 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is dark grayish brown, firm silty clay; and the lower part is olive brown, firm silty clay loam that has some lime concretions. The underlying material, to a depth of 60 inches, is olive brown silty clay loam. Brownish yellow mottles are common in the underlying material and lower part of the subsoil.

Included in mapping and making up 10 percent of the complex in places are small areas of Crete soils. They are on broader, flat areas.

The Wymore soil has slow permeability and high available water capacity. Runoff is slow. Content of organic matter is moderate, and natural fertility is medium. In most places, phosphorus has been added to established lawns, and is generally high or very high in content in the surface layer. This soil releases moisture slowly to plants. Shrink-swell potential is high.

Wymore soil, which makes up the open part of the complex, is used for parks, open space, building sites, lawns, or gardens. The soil has good potential for lawns, vegetable and flower gardens, trees, and shrubs. It has fair potential for recreation areas and for most engineering uses.

The soils in this complex are suited to gardens and lawns. However, because the soils are droughty, irrigation is commonly needed during the summer. Applications of nitrogen are needed on lawns to maintain fertility. Gardens can need phosphorus. The soils are hard to work in areas where the subsoil is exposed. They are hard when dry and sticky when wet. Topsoil should be stockpiled and respread over the surface after construction.

Trees and shrubs grow well in these soils. They supply shade along streets and in parks, beautify lawns and homes, provide privacy, and reduce noise. Many American elm trees which have died from Dutch elm disease have been replaced with a different species of tree. Pin oak trees commonly need applications of iron. Landscaping services are provided throughout Lancaster County.

Areas used for athletic fields and other recreation purposes require little land shaping, but landscaping can be needed on flat areas to improve surface drainage. These clayey soils tend to be muddy during the spring. In places, play areas need to be surfaced with asphalt, concrete, or gravel.

Foundations and basement walls should be designed to withstand the shrinking and swelling of these soils. The grounds around buildings should be landscaped to drain surface runoff away from basement walls. Drain spouts are needed to carry the water several feet away from the buildings. In places, water perches on top of the underlying glacial till and causes seepage into basements. Drainage is needed in these areas. Streets and parking lots need to be surfaced to control the muddy condition under rainfall and to reduce the dust during dry

periods. Onsite investigation is needed to properly evaluate and plan development of specific sites.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

UxC—Urban land-Wymore-Sharpsburg complex, 2 to 7 percent slopes. This complex consists of areas of Urban land and deep, gently sloping, moderately well drained Wymore and Sharpsburg soils. Wymore soils are on lower side slopes, and Sharpsburg soils are on upper side slopes and narrow ridges. Areas range from 40 to 2,000 acres. About 50 percent is Urban land, 20 percent Wymore soils, and 15 percent Sharpsburg soils. The Urban land areas, Wymore soils, and Sharpsburg soils are so intricately mixed or in such small areas that it is not practical to separate them in mapping.

Urban land consists of streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. The soil material beneath the Urban land is similar to the material in the Wymore and Sharpsburg soils.

Typically, the Wymore soil has a very dark brown surface layer about 11 inches thick. The upper part is friable silty clay loam, and the lower part is firm silty clay. The subsoil is about 27 inches thick. The upper part is dark grayish brown, firm silty clay and the lower part is light brownish gray, firm silty clay loam. The underlying material, to a depth of 60 inches, is light brownish gray silty clay loam. The underlying material and lower part of the subsoil are calcareous.

Typically, the Sharpsburg soil has a surface layer of very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is dark brown, firm silty clay; the next layer is brown, firm silty clay; the next layer is brown, friable silty clay loam; and the lower part is light olive brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam. The Sharpsburg soil is free of carbonates to a depth of 60 inches.

Included in mapping and making up about 15 percent of the complex are small areas of Colo, Judson, Mayberry, and Pawnee soils. Colo soils are on narrow bottom lands adjacent to drainageways. Judson soils are on colluvial foot slopes. Mayberry soils and Pawnee soils developed on glacial till and are on lower parts of side slopes.

Permeability is slow in the Wymore soil and moderately slow in the Sharpsburg soils. In both soils available water capacity is high, and content of organic matter is moderate. Runoff is medium on the vegetated areas. Natural fertility is medium in the Wymore soils and high in the Sharpsburg soils. Because mixed fertilizer has been applied to most lawns, the content of available phosphorus is generally high or very high in the surface layer. If the subsoil has been exposed, these soils are hard to work. Reaction of the surface layer ranges from strongly acid to slightly acid. Shrink-swell potential is high.

The Wymore and Sharpsburg soils, which make up the open areas of the complex, are used for parks, open space, building sites, lawns, and gardens. These soils have good to fair potential for lawns, vegetable and flower gardens, trees, and shrubs. They have fair potential for recreation and for most engineering uses.

Bluegrass lawns grow well in these soils; however, weekly irrigation is needed during the summer. Frequent applications of nitrogen are needed during the growing season, and in many places, iron is needed. Natural fertility and availability of water to plants is higher in those soils where the surface layer has not been removed or covered with clayey subsoil. Vegetable and flower gardens are easy to work if the original surface layer has been kept. Tilth can be improved by adding organic matter such as manure or compost and maintained by fall plowing and keeping traffic to a minimum. Dark, friable soil can be used as potting soil around trees and shrubs to help plants become established. Pin oak trees may need applications of iron. Soil erosion is a serious hazard in this complex if soils are disturbed and left bare and exposed for a considerable period of time. Siltation downstream can damage lawns, storm sewers, or streams.

Steel needs to be used in the construction of foundations and basement walls to prevent damage from the shrinking and swelling of these soils. The hazard of shrink-swell can be reduced if the abutting soil material is replaced with material having lower content of clay. Seepage is a problem in many places during rainy periods. Artificial drainage, footing drains, and basement sump pumps help to reduce or overcome wetness. In places, poor surface drainage causes seepage into basements. Downspouts help to drain rainwater away from buildings. Sanitary facilities should be connected to public sewers and treatment facilities. The construction of buildings on the drains that cross these soils should be avoided.

Because Sharpsburg and Wymore soils are susceptible to shrink-swell and frost action, roads need occasional repair. The hazards of dust during dry periods and impassable muddy roads during rainy periods are not problems in this complex because most streets are paved.

These soils have moderate limitations for picnic areas and playgrounds. The surface dries slowly in spring when precipitation is heavy. Well maintained grass reduces the muddy condition. Play areas and walkways can require special surfacing. Land shaping is needed for athletic fields that require a nearly level surface. In landscaping these soils, the friable topsoil should be stockpiled and respread over the surface. Onsite investigations are essential to properly evaluate and plan the development of sites for specific purposes.

This complex is not assigned to a capability unit, range site, or windbreak suitability group.

Wb—Wabash silty clay, 0 to 1 percent slopes. This nearly level, poorly drained soil is on bottom lands. It is

occasionally flooded. Areas are generally irregular in shape and range from 5 to 250 acres.

Typically, the surface layer is about 21 inches thick. The upper part is black, firm silty clay, and the lower part is very dark gray, very firm silty clay that has dark brown mottles. The subsoil, to a depth of 60 inches, is silty clay. The upper part is extremely firm and black with olive brown mottles; the lower part is very firm and very dark gray. In a few places, the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Kennebec soils and Zook soils. These soils have less clay in the subsoil and are on the higher parts of the landscape. In most areas, they make up 10 to 25 percent of the map unit. Also included are a few small areas of saline-alkali soils.

This Wabash soil has very slow permeability and moderate available water capacity. Runoff is very slow. Natural fertility is high, and content of organic matter is moderate. The soil absorbs and releases moisture slowly. The silty clay surface layer and firm consistency make this soil difficult to work. The clayey soil restricts movement of water, air, and plant roots. The seasonal high water table is 0 to 1 foot below the surface; however, during dry periods, it is often at a depth of more than 6 feet. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. The rest is mainly in tame grass pasture. This soil has good potential for grass and wildlife habitat. The potential is fair for cultivated crops and trees and poor for most engineering uses.

This soil is suited to wheat, soybeans, grain sorghum, and legumes. Grain sorghum and soybeans can be planted late in spring. Wheat is commonly planted during the fall. Alfalfa is suited to this soil, and the deep tap roots help to open the dense, clayey subsoil. Wetness is the principal limitation to tillage. The slow runoff after rain causes delay in tillage and planting. Surface drainage can be improved by arranging row direction and by land grading. Fall plowing improves soil tilth for the following spring. Excessive compaction needs to be avoided, particularly when the soil is wet, because compaction further reduces permeability. Use of crop residue adds to the content of organic matter. Because this soil is droughty during periods of low rainfall, irrigation during the summer is beneficial. Both sprinkler and gravity type irrigation can be used.

This soil is suited to bromegrass, tall fescue, and reed canarygrass for tame grass pasture. A legume in the grass mixture increases the forage production and opens the dense subsoil.

Few areas of this soil are in native range; however, this permanent cover of grass is a dependable source of food for livestock. Native grass can be grazed or cut for hay. Vegetation is influenced mainly by the slow infiltration rate and the additional moisture received from periodic flooding. Kentucky bluegrass, western ragweed, and sedges invade the range if it is overgrazed. The sod can be damaged if livestock graze when the soil is wet.

Few tree windbreaks are planted because houses or feedlots generally are not built on this wet, clayey soil. Trees that can tolerate occasional wetness survive and grow well. At times, the establishment of seedlings is difficult during wet years. Controlling the abundant and persistent herbaceous vegetation on this soil during establishment of trees is a concern in management.

The diversified vegetation supplies food and cover for many kinds of wildlife. The grain left in the crop residue of grain sorghum and wheat provides food for pheasants, quail, and many songbirds. Good stands of prairie cordgrass grow along fence rows, and many trees and shrubs grow on this soil and on nearby soils. The wooded areas are good habitat for deer.

This wet, clayey soil has severe limitations for recreation uses. In places, these soils can be excavated for ponds.

This soil is poorly suited to homesites and other building sites, septic tank absorption fields, and sewage lagoons. Flooding, wetness, very slow permeability, and very high shrinking and swelling are limitations. Roads need to be elevated to prevent damage from flooding.

This soil is in capability unit IIIw-1 dryland and IIIw-1 irrigated. It is in Clayey Overflow range site and windbreak suitability group 2.

Wt—Wymore silty clay loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on narrow ridgetops of loess uplands (fig. 14). Areas are long and narrow and range from 3 to 500 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is about 30 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is dark grayish brown, firm silty clay; the lower part is mixed grayish brown and light olive brown, firm silty clay loam that has a few small lime concretions. The underlying material is mixed grayish brown and light olive brown silty clay loam. It is noncalcareous. Small, very gently sloping areas occur in places. The surface layer is silt loam in a few places.

Included with this soil in mapping are small areas of somewhat poorly drained Butler soils. They make up less than 5 percent of the map unit.

This Wymore soil has slow permeability. Runoff is slow. Available water capacity is high, and content of organic matter is moderate. Natural fertility is medium. Below the plow layer, the content of phosphorus is low. Reaction of the surface layer is medium acid; therefore, lime is generally needed. Moisture is released slowly to plants. This soil is easily worked, but it dries somewhat slowly after rain. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential of the subsoil is high.

Most of the acreage of this soil is used for cultivated crops. The rest is used for farmstead sites and homesites. The soil has good potential for common cultivated crops, grass, and trees. It has good potential for wildlife

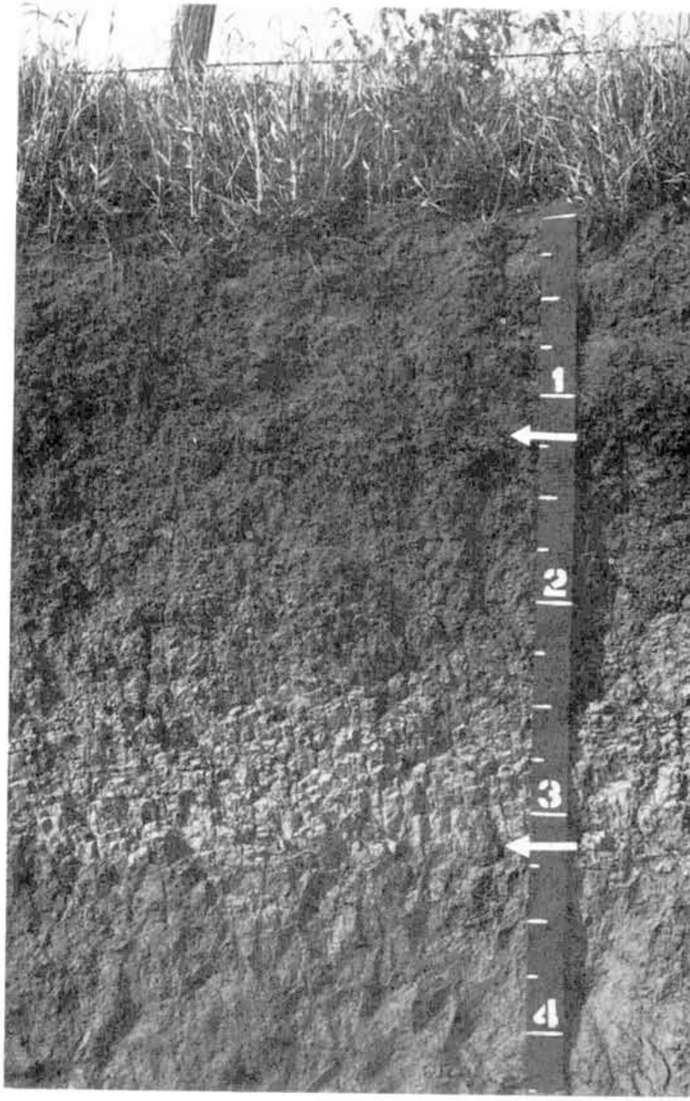


Figure 14.—Profile of Wymore silty clay loam, 0 to 1 percent slopes, that formed in Peorian Loess. The subsoil, about 24 inches thick, is light colored in the lower part.

habitat and recreation uses and poor potential for most engineering uses.

This soil is best suited to grain sorghum and wheat, the most common crops. Corn and alfalfa are also grown. Grain sorghum, however, is more resistant to drought than those crops, and winter wheat is more favored because it needs the most moisture during spring and early in summer when soil moisture is most abundant. The clayey subsoil is the main limitation. It restricts movement of air, water, and roots. Generally, row crops can be grown year after year without reduction in the content of organic matter. Using minimum tillage, tilling when the soil is not too wet, returning crop residue to the soil, growing deep rooted legumes to maintain soil structure, and adding fertilizer as needed to supply plant nutrients are desirable management practices. During prolonged dry periods, this soil is somewhat droughty. The soil is suited to furrow, border, or sprinkler irrigation. However, sprinkler irrigation is generally used because this soil is adjacent to larger areas of gently sloping soils which tend to make gravity systems impracticable. Sufficient water for irrigation is not available in most areas.

Few areas of this soil are used for pasture or range. The soil, however, is well suited to grass and tame grass pasture or to native grass range. Bromegrass and tall fescue are cool-season grasses that grow well. Forage production can be increased if a legume is added to the seed mixture. Applications of commercial fertilizer increase production. If native grass is planted, little care other than grazing management is needed to maintain forage production.

This soil is generally on the highest elevation in the area and very few native trees are available for wind protection. Tree windbreaks protect buildings and provide shelter for livestock. Properly designed and placed farmstead windbreaks can be used to keep drifting snow out of farmyards. Trees need to be protected from livestock and fire, and young trees need to be protected from rabbits. Drought and moisture competition from weeds and grasses are the principal hazards. Cultivation or chemicals can be used to kill weeds.

The principal wildlife game is pheasants. However, trees and shrubs planted in windbreaks supply habitat for many other kinds of wildlife.

Most garden crops grow well in this soil, but supplemental irrigation is generally needed for moisture. If land shaping has exposed the clayey subsoil, topsoil needs to be spread on the surface. The friable topsoil is more fertile and less droughty than the subsoil.

This soil provides many scenic building sites. Only minor land shaping is needed for playgrounds, athletic fields, airfields, or homesites. In places, the use of fill around buildings helps to provide surface drainage. Foundations and basement walls should be designed to withstand the shrinking and swelling of the soil. In some areas, water is perched on underlying glacial till and tile drains can be used to prevent seepage into basements. This soil is poorly suited to septic tank absorption fields because of slow permeability; however, a larger than average leach field helps to overcome this limitation. Good sites for sewage lagoons are frequently available. Because this soil dries slowly after rainfall, roads need to be elevated and gravelled or paved.

This soil is in capability units IIs-2 dryland and IIs-1 irrigated. It is in Clayey range site and windbreak suitability group 4.

WtB—Wymore silty clay loam, 1 to 3 percent slopes. This very gently sloping, moderately well drained soil is on narrow ridgetops of loess uplands. Areas are long and narrow and range from 15 to 300 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is very dark grayish brown, firm silty clay; the middle part is dark grayish brown, firm silty clay; and the lower part is dark grayish brown, firm silty clay loam. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam. The middle part of the subsoil has brown mottles. The lower part of the subsoil and underlying material have lime concretions. In places, this soil is noncalcareous to a depth of 60 inches. Small areas of this soil are nearly level or gently sloping.

Included with this soil in mapping are small areas of Sharpsburg soils. These soils are in the slightly higher areas and make up less than 5 percent of the map unit.

This Wymore soil has slow permeability. Runoff is medium. Available water capacity is high, and content of organic matter is moderate. Natural fertility is medium and is easily maintained. Content of available phosphorus is low. Applications of lime are needed for legumes. Tilth is generally good, and the soil is easily tilled through a fairly wide range of moisture content. Reaction in the surface layer is medium acid. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential of the subsoil is high.

Most of the acreage of this soil is used for cultivated crops. The rest is used for farmstead sites and homesites. The soil has good potential for common cultivated crops, grass, and trees. It has good potential for wildlife habitat and recreation uses and poor potential for most engineering uses.

This soil is best suited to grain sorghum and wheat. Corn, soybeans, and alfalfa are also grown. Grain sorghum tolerates hot, dry periods. Wheat is a cool-season crop that utilizes moisture stored from the previous season as well as the moisture from rainfall early in spring. A good cropping system, use of crop residue, application of fertilizer, contour farming, and terracing are needed to help control erosion and conserve moisture. Because this soil is generally adjacent to larger areas of gently sloping soil, sprinkler irrigation is more practicable than the gravity system of irrigation. Irrigation runoff at the ends of fields needs to be controlled and reduced to conserve water.

Some areas of this soil are in grass pasture and are used to graze horses. Bromegrass and tall fescue respond well to applications of fertilizer and irrigation water. Grazing should be controlled. Pasture plants should maintain not less than 4 inches of leaf growth at all times and should have 6 to 8 inches of growth by the time of the first killing frost in fall. This vegetation supplies food for growth the following spring. Season-long grazing can be provided by combining cool-season pasture grasses with temporary sudangrass. A more stable forage production program is obtained if native warm-season perennial grasses are added to this combination.

Trees planted in windbreaks survive and grow fairly well on this soil. Drought and moisture competition from weeds and grasses are the principal hazards. If properly designed and placed, windbreaks can be used to control drifting snow, protect homes and livestock, and improve habitat for wildlife. Colorado blue spruce is generally not planted in windbreaks; however, it grows well in environmental plantings.

This soil produces grain and seed crops that provide good supplies of food for wildlife. Habitat areas can be developed, but proper placement and distribution of vegetation is required.

This soil has moderate limitations for camp areas, picnic areas, and playgrounds because the surface layer dries slowly after rainfall. The soil is at high elevation, and areas commonly provide scenic views of the countryside.

Foundations and basement walls should be designed to withstand the shrinking and swelling of this soil. In some areas, water is perched on underlying glacial till, and seepage into basements can occur. Tile drains or sump pumps help to prevent seepage. Although this soil is poorly suited to septic tank absorption fields because of slow permeability, good sites are frequently available for sewage lagoons. The friable surface layer should be stockpiled and respread over the lawn area after grading has been finished. The clayey subsoil should not be exposed because it is difficult to work and it absorbs moisture slowly. The very gentle slopes and elevation of this soil provide good sites for roads and airfields, but because of the hazard of shrink-swell, replacement or modification of soil material may be required.

This soil is in capability units IIe-2 dryland and IIe-1 irrigated. It is in Clayey range site and windbreak suitability group 4.

WtC2—Wymore silty clay loam, 3 to 7 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on narrow ridgetops and side slopes of loess uplands. Cracks at the surface 1 to 2 inches deep are common when the soil is dry. Areas are irregular in shape and range from 3 to 600 acres.

Typically, the surface layer is very dark brown, firm silty clay loam about 8 inches thick. The subsoil is about 30 inches thick. The upper part is dark brown, firm silty clay; the middle part is dark grayish brown, firm silty clay; and the lower part is olive brown, friable silty clay loam that has a few medium accumulations of lime. The underlying material, to a depth of 60 inches, is olive gray with many small accumulations of lime. The surface layer of this soil has more clay than other soils that are not eroded because the subsoil has been mixed with the surface layer.

Included with this soil in mapping are small areas of Colo, Judson, Nodaway, Pawnee, and Sharpsburg soils. Frequently or occasionally flooded Colo soils and Nodaway soils are on areas of bottom land that are too narrow to be separated on the soil map. The moderately permeable Judson soils are on colluvial foot slopes. Pawnee soils are on lower side slopes, and Sharpsburg

soils are on upper side slopes and narrow ridges. The included soils make up 5 to 20 percent of most mapped areas.

This Wymore soil has slow permeability and high available water capacity. Runoff is medium. Moisture is released slowly to plants. The surface layer has lost some of its original granular structure and is difficult to work in most places. The clayey subsoil tends to limit root penetration and restrict water movement. Cracks that develop in the soil during dry periods increase initial water intake when rainfall occurs. Content of organic matter is moderate, and natural fertility is medium. Content of available phosphorus ranges widely in the plow layer, depending on amounts in previous applications. Reaction of the surface layer is medium acid or slightly acid. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops. A few areas are used for tame grass pasture. Less than 5 percent of the acreage has never been farmed and is still in native grass. This soil has good potential for cultivated crops, grass, trees and wildlife habitat. The potential is poor for most engineering uses.

This soil is best suited to grain sorghum and wheat, the most commonly grown crops. Corn, alfalfa, oats, and soybeans are also grown. Grain sorghum survives better in hot, dry periods than corn. Wheat is a desirable crop for this soil because it first uses moisture stored in the soil and then uses moisture provided by the rainfall early in spring. Water erosion is the principal hazard if these soils are cultivated. Conservation of available moisture by slowing or preventing runoff is needed. Maintenance of fertility, content of organic matter, and soil tilth are other management concerns. The use of terraces, grassed waterways, and contour farming helps to control runoff and erosion. Unless mechanical practices are used, row crops should be limited and close growing crops should be grown to help protect the soil from erosion. Proper management of crop residue insures a high rate of water intake and maintains the content of organic matter, soil structure, and soil tilth. Lime is commonly needed to help establish alfalfa plants. Grain sorghum and corn generally respond well to additional nitrogen. Application of phosphorus fertilizer is needed for sustained production of most crops. In dry years, however, heavy applications of fertilizer may not increase production because the heavy clay subsoil releases moisture slowly. In the few areas of this soil that are irrigated with a center-pivot system, water should be applied at a very low rate. Control of irrigation water is needed to reduce the amount of runoff at the end of the field.

Tame grass pastures are made up mostly of cool-season grasses. These grasses begin to grow early in spring and grow rapidly during May and June. They commonly become dormant during the warm months of July and August, and grow rapidly again during the cool months in fall. Grazing early in spring during a critical period of growth damages established pastures because at this time the grasses feed on reserves stored in their roots and rhizomes. This period of growth continues until the grasses are 5 to 6 inches high. In addition, grazing should be controlled so that grasses produce 6 to 8 inches of growth before the first killing frost in fall. During this period the grasses store food reserves for growth the following spring. Weeds in pastures are best controlled by chemicals. Application of fertilizer, particularly nitrogen, is needed for highest production. Addition of phosphate fertilizer is generally beneficial to pasture crops that include a legume. Bromegrass is the most common grass used in tame pasture, but tall fescue is also grown. If alfalfa is included in the seed mixture, forage production is increased. Sprinkler irrigation can be used in tame grass pasture, but application of water should not exceed the intake rate of the soil.

Areas of native grass range are generally adjacent to larger areas of grassland on less arable soil. Proper grazing use, deferred grazing, and rotation-deferred grazing help to maintain or improve the range condition.

This soil provides good sites for tree windbreaks. Drought and competition for moisture from weeds and grasses are the main hazards to seedlings. Many farmsteads are built on this soil. Properly designed and placed windbreaks keep drifting snow out of farmyards. Windbreaks reduce home heating costs, provide shelter for livestock, and improve conditions for wildlife. A few trees grow naturally along the drainageways that cross this soil.

Grain sorghum and wheat supply excellent food for pheasants. Mourning doves are common. Small farm ponds along drainageways provide water for many kinds of wildlife. A few of the larger ponds are stocked with fish. Wooded tracts along streams provide habitat for songbirds and such game species as deer, bobwhite quail, squirrels, and cottontail rabbits.

This soil has moderate limitations for picnic areas, playgrounds, and golf courses because this clayey soil dries slowly after rainfall. The muddy condition can be reduced if a good grass cover is maintained. Bluegrass fairways are difficult to maintain during the summer months unless they are irrigated.

This soil is fairly well suited to lawns and gardens; however, it is often difficult to work. Garden residue can be plowed under in the fall to improve tilth for the following spring. Applications of manure also improve the workability of the soil and maintain the content of organic matter and fertility. Many horticultural plants grow well in this soil. Information on species and varieties is available from local nurserymen.

Many small dams have been built along the drainageways that cross this soil. Coating of corrugated metal tubes used in construction is needed to reduce corrosivity. Erosion needs to be controlled upstream from dams to prevent damage from silt to the pond areas. Foundations and basement walls should be designed to withstand the shrinking and swelling of the soil. Replacing

the abutting soil material with material of lower clay content that has lower shrink-swell properties is desirable. In places, seepage into basements is a hazard. Wetness increases on the lower slopes and on areas near such glacial soils as the Pawnee or Mayberry soils. Artificial drains should be installed around footings during building construction. Septic tank absorption fields do not work properly on this soil because of slow permeability. However, the septic field can be enlarged. Sewage lagoons can be used on many areas.

Because this soil is erodible, roadbanks need to be planted to a well adapted grass or grass mixture, and the slope kept to a minimum grade. Local roads need to be elevated and paved or gravelled to shed water.

This soil is in capability unit IIIe-2 dryland and IVe-1 irrigated. It is in Clayey range site and windbreak suitability group 4.

WtD—Wymore silty clay loam, 7 to 11 percent slopes. This deep, strongly sloping, moderately well drained soil is on side slopes of loess uplands along drainageways. Areas are irregular in shape and range from 3 to 40 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 12 inches thick. The subsoil is about 36 inches thick. The upper part is very dark grayish brown, firm silty clay; the next layer is dark grayish brown, firm silty clay; the next layer is grayish brown, firm silty clay; and the lower part is grayish brown, friable silty clay loam. The underlying material, to a depth of 60 inches, is grayish brown silty clay loam. The underlying material and the lower part of the subsoil have brownish yellow mottles, and they have a few lime concretions in places. In many areas, glacial till is 3 to 5 feet below the surface.

Included with this soil in mapping are small areas of Pawnee soils and Sharpsburg soils. Sharpsburg soils are on the higher elevations, and the Pawnee soils are generally on the lower slopes. The included soils make up 5 to 10 percent of the map unit.

This Wymore soil has slow permeability and high available water capacity. Runoff is medium. Content of organic matter is moderate, and natural fertility is medium. The clayey subsoil is not easily penetrated by plant roots. Moisture is released slowly. Reaction of the surface layer is medium acid. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential of the subsoil is high.

Most of the acreage of this Wymore soil is in native grass. The rest is used for cultivated crops or tame grass pasture. The small, cultivated areas are interspersed with areas of grass. The soil has fair potential for cultivated crops and poor potential for most engineering uses. The potential is good for grass, windbreaks, and wildlife habitat.

This soil is suited to small grain and alfalfa. Grain sorghum grows well, but use should be limited in the cropping system. Application of lime is needed if legumes are grown. This soil has good tilth and is easy to work; however, the friable surface layer erodes under cultivation unless conservation practices are used. Terraces, grassed waterways, contour farming, and use of crop residue as mulch help to control runoff and erosion. This soil is poorly suited to irrigation.

Tame grass pastures can be grown in the cropping sequence. If pasture production declines, the old stand can be plowed under and desirable grasses reestablished. If a legume is included in the pasture mixture, phosphate fertilizer needs to be added to the soil for sustained production.

This soil is well suited to range. The kind of vegetation on this soil is determined mainly by the clayey, slowly permeable subsoil. The more desirable grasses decrease under increased grazing. A planned grazing system helps to improve range condition. The distribution of livestock in a pasture can be improved by proper placement of fences and watering and salting facilities.

Few tree windbreaks are planted on this soil. However, adapted species survive and grow fairly well on this soil. Drought and moisture competition from weeds and grasses are the principal hazards. Some trees that grow naturally along the drainageways provide protection for livestock and food and cover for wildlife. Bobwhite quail and pheasants are plentiful.

In some areas, water that perches on underlying glacial till can cause seepage into basements. Tile drains around footings or sump pumps help to prevent seepage. Outlets are generally available. Foundations and basement walls need to be designed to withstand the shrinking and swelling of the soil. Replacing the abutting soil material with material having a low clay content and a low shrink-swell potential is desirable. Strong slopes commonly require land shaping. In landscaping these soils, the friable topsoil should be stockpiled and spread over the surface. The clayey subsoil should not be exposed; it is hard to work and droughty. Sites for houses with walkout basements are generally available. This soil is poorly suited to septic tank absorption fields because of slow permeability. It is not suited to sewage lagoons because of slope. Deep cuts that are commonly made during road construction need to be seeded to adapted grasses.

This soil is in capability unit IVe-2 dryland. It is in Clayey range site and windbreak suitability group 4.

WtD3—Wymore silty clay, 5 to 9 percent slopes, severely eroded. This deep, strongly sloping, moderately well drained soil is on side slopes of loess uplands along drainageways. Cracks at the surface 1 to 2 inches deep are common. Areas are irregular in shape and range from 3 to 200 acres.

Typically, the surface layer is very dark grayish brown, firm silty clay about 6 inches thick. The subsoil is about 17 inches thick. The upper part is dark grayish brown, firm silty clay; the middle part is grayish brown, firm silty clay loam; and the lower part is olive gray, friable silty clay loam. The underlying material, to a depth of 60

inches, is olive gray silty clay loam. Yellowish red mottles are common in the subsoil and underlying material. The underlying material has soft, very dark brown accumulations of iron-manganese oxide. Erosion has been very severe in a few places, and the lower part of the subsoil or underlying material is exposed at the surface. About 35 percent of each mapped area is only moderately eroded. The subsoil is about 27 inches thick on these less eroded areas, and the upper part of the subsoil is very dark grayish brown or dark brown. In many areas, glacial till is 3 to 5 feet below the surface.

Included with this soil in mapping are small areas of frequently or occasionally flooded Colo soils and Nodaway soils along narrow drainageways and Pawnee soils on lower side slopes. In most areas, they make up 5 to 10 percent of the map unit.

This Wymore soil has slow permeability and high available water capacity. Runoff is medium or rapid depending on vegetative cover and mechanical conservation practices. Content of organic matter is moderately low, and fertility is medium. This soil is hard to work because the clayey subsoil is exposed at the surface. This exposed subsoil is hard when dry and sticky and plastic when wet. The content of nitrogen and phosphorus are generally low. Reaction of the surface layer is medium acid or slightly acid. A seasonal high water table is perched 1 to 3 feet below the surface in the spring in some years. Shrink-swell potential is high.

Most of this soil is used for cultivated crops. The rest is mainly used for tame grass pasture. The soil has poor potential for cultivated crops and for most engineering uses. The potential is good for grass, windbreaks, and wildlife habitat.

This soil is best suited to wheat, alfalfa, and grain sorghum, and these crops are most commonly grown. A cropping system can be used that consists mainly of close growing crops, for example, small grain and legumes. Use of row crops in the cropping sequence needs to be limited. Water erosion is a severe hazard on this soil. Control of surface water, improvement of tilth, improvement in the content of organic matter, and maintenance of fertility are concerns of management. This soil is droughty during periods of low rainfall. Downstream siltation can be a hazard if this soil erodes. Terraces, sod waterways, and contour farming help to control runoff and erosion. Returning crop residue to the soil improves the content of organic matter, tilth, fertility, and the intake of water. Tillage should be kept to a minimum. Use of green manure crops and applications of barnyard manure are also beneficial. Heavy applications of fertilizer should be avoided in dry years because the clayey subsoil does not absorb or release enough moisture for plants to utilize the nutrients. This soil is not suitable for irrigation.

This soil is suited to tame grass pasture. Bromegrass is the most commonly grown grass, but tall fescue is also grown. Alfalfa included in the mixture improves forage production. Gullies and rills form in overgrazed areas.

This soil can be seeded to native grass to provide a permanent cover. After seeding, little care other than management of grazing is needed to maintain forage production. Native grass can be grazed or cut for hay.

Few tree windbreaks are planted on this soil, although adapted species survive and grow fairly well. Trees should be planted on the contour to reduce the hazard of erosion.

Pheasants and doves are common. The grassed waterways provide good nesting areas. Grain sorghum and wheat supply food. Cottontail rabbits are abundant in areas dissected by brushy draws.

In places, good sites are available for dams; however, erosion needs to be controlled upstream to avoid siltation of ponds. Coating of corrugated metal tubes used in dam construction is needed. Seepage spots during wet periods are a hazard to buildings with basements. Tile drains should be installed around footings. Outlets are generally available downslope. Basement walls should be designed to prevent damage from shrinking and swelling of the soil. Slow permeability and a few wet spots limit the use of this soil for septic tanks, and slope limits use for sewage lagoons. This soil is hard to work and is droughty. Lawn sites can be improved by topdressing with 6 inches of friable, dark topsoil. Driveways to houses may cause a problem if drains have to be crossed. Unless roads are elevated and gravelled, they are frequently too muddy to use.

This soil is in capability unit IVe-4 dryland. It is in Clayey range site and windbreak suitability group 9.

Zc—Zoe silty clay loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on bottom lands. It is occasionally flooded. Areas are irregular in shape and range from 10 to 120 acres.

Typically, the black surface layer is about 39 inches thick. The upper part is friable silty clay loam; the middle part is firm silty clay; the lower part is firm silty clay loam. The subsoil, to a depth of 60 inches, is firm silty clay. The upper part is very dark gray, and the lower part is dark gray. In places, salt crystals are evident in the surface layer. The subsoil has a few small soft accumulations of lime.

Included with this soil in mapping are small areas of Wabash soils. Wabash soils are not saline, and they have more clay in the subsoil than Zoe soils. The included areas make up 5 to 10 percent of the map unit.

This Zoe soil has slow permeability and moderate available water capacity. Runoff is slow. The soil tends to pond in wet seasons. Slight to moderate amounts of soluble salts are between a depth of 10 and 24 inches, and content of exchangeable sodium is excessive. Reaction in the upper 8 inches of the surface layer ranges from medium to neutral. Natural fertility is low on the moderately affected saline spots and medium on the less affected areas. Many of the moderately saline spots are difficult to till. They are hard when dry and sticky when wet. Content of organic matter is moderately low.

The seasonal high water table is 1 foot to 3 feet below the surface. However, the water table is frequently perched, and during dry periods it can be as much as 7 feet below the surface. Moisture is released slowly to plants. Shrink-swell potential is high.

Most of the acreage of this Zoe soil is used for cultivated crops; however, some areas are in native grass. This soil has good potential for grass and wildlife habitat. It has fair potential for cultivated crops and poor potential for tree windbreaks and for most engineering uses.

This soil is suited to grain sorghum, wheat, and alfalfa. Wheat can be established in fall when the soil is not so wet as in spring and harvested in summer when the soil is likely to be dry. Grain sorghum is frequently grown instead of corn because it can be planted late in spring. The growth of crops on this soil is uneven because plants will have very little growth in the more saline spots as compared to the nearly normal growth of plants in the less affected areas. The principal concern of management is excessive salinity and alkali which is toxic to most plants. Other concerns are improving drainage and tilth and maintaining a balance of soil moisture and fertility. Proper placement of rows, bedding of surfaces, land grading, and land leveling improve drainage. Use of crop residue, green manure crops, and additions of barnyard manure improve internal drainage by improving tilth in the surface. Improvement of drainage and tilth allows moisture to enter the soil more easily. Gypsum and sulfur commonly can be used to neutralize the alkali, but soil tests are needed to determine the amount. If drainage is improved, saline salts do not accumulate. Irrigation helps gypsum to neutralize sodium and leach salts from the soil. All types of irrigation systems can be used. Applications of water in sufficient amount to serve the need of the crop and at a rate that permits maximum absorption are important considerations.

This soil is well suited to tame grass pasture. Tall wheatgrass and western wheatgrass can be grown and used for either hay or pasture. Irrigation increases forage production of wheatgrass. Fertilizer needs should be determined by soil tests. Weeds should be controlled by chemicals. Mowing damages the taller grasses as well as the weeds.

Native grass range is a fair source of forage during the summer. Plant species vary widely because amounts of salinity and wetness differ within the map unit. Much of the range is overgrazed. Areas are invaded by less productive plants, for example, Kentucky bluegrass, western ragweed, and sedges on the less saline areas and inland saltgrass and blue grama on the more saline soils. Good management that includes proper amount of use, deferred grazing, and reseeding is needed to restore range condition.

This soil provides poor sites for tree windbreaks. Adapted species have fair to poor chances of survival and growth. The saline condition of the soil is the principal hazard. Planting species that are most tolerant of soluble salts and exchangeable sodium reduces this hazard.

Grass and grain crops supply food and cover for pheasants and mourning doves. A few shallow ponded areas are suitable habitat for waterfowl and a number of furbearers. This soil is poorly suited to recreation uses other than hunting.

This soil is limited for engineering uses because of wetness, salinity, high shrink-swell, and slow permeability. Septic tank absorption fields, sewage lagoons, and roads should be built on other soils that have more favorable conditions for construction. If this soil is crossed by roads, roadbeds should be elevated, and the soils should be drained. Coating of buried pipes is needed because the soil is corrosive to metal.

This soil is in capability units IVs-1 dryland and IVs-1 irrigated. It is in Saline Lowland range site and windbreak suitability group 8.

Zo—Zook silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands. It is occasionally flooded. Areas are irregular in shape and range from 3 to 200 acres.

Typically, the surface layer is friable silt loam about 20 inches thick. The upper part is very dark gray, the middle part is very dark brown, and the lower part is very dark grayish brown. The lower part is silty clay loam in places. The subsoil is about 37 inches thick. The upper part is very dark gray, firm silty clay loam; and the lower part is black, very firm silty clay. The underlying material, to a depth of 60 inches, is very dark grayish brown silty clay loam that has reddish brown mottles.

Included with this soil in mapping are small areas of Colo, Kennebec, and Wabash soils. The moderately well drained Kennebec soils are near stream channels. Colo soils and the poorly drained Wabash soils are intermingled with Zook soils on bottom lands that are somewhat distant from the main stream channel. The included soils make up 5 to 15 percent of the map unit in most areas.

This Zook soil has slow permeability and high available water capacity. Runoff is slow. Content of organic matter is moderate, and natural fertility is high. The seasonal high water table is 2 to 4 feet below the surface. This soil is easy to work, and tilth is generally good. Moisture is readily available to plants. Reaction of the surface layer is medium acid or slightly acid. Shrink-swell potential of the subsoil is high.

Most areas of this Zook soil are used for cultivated crops; however, some areas are used for grass and trees. The soil has good potential for cultivated crops, grass, and wildlife habitat. The potential is fair for trees in windbreaks and poor for most engineering uses.

Grain sorghum is generally planted later than corn, and wheat or legumes are planted during mild fall weather. This soil is suited to corn if the soil is drained or if the weather is favorable. Wetness is the main limitation. The soil dries slowly in spring and during rainy periods, and tillage is commonly delayed. Internal drainage can be improved by tile drains. Outlets are generally available. Surface drainage can be improved by proper placement

of rows or land grading. Plant diseases and insect carryovers are reduced if crops are grown in sequence. In dry years, wetness of the soil is beneficial to crops. This soil is suited to gravity and sprinkler irrigation systems. In most areas, some degree of leveling is needed for furrow and border irrigation. Exposure of the firm subsoil should be avoided because the subsoil is difficult to till and crops respond poorly if the subsoil is exposed at the surface. Reducing and controlling runoff of irrigation water at the end of the field is desirable. Additions of commercial fertilizer, mainly nitrogen and phosphorus, are needed. Legumes planted in the cropping sequence help to keep the subsoil open and improve permeability.

This soil is well suited to tame pasture. Bromegrass, tall fescue, and reed canarygrass grow well. Alsike clover, Ladino clover, or birdsfoot trefoil included in the grass mixture increase forage production. If bluegrass is grown for sod, irrigation is needed.

Native grass can be planted to provide a dependable source of forage during the summer months. Range is invaded with bluegrass, sedges, and weeds if it is overgrazed. A planned grazing system that includes native grass range and tame grass pasture increases length of the grazing period.

This soil is suited to windbreaks if trees are tolerant of occasional wetness. Chances of survival and growth of adapted species are good. This soil is one of the best sites in the county for plantings of black walnut trees. Livestock need to be excluded from areas where black walnut or other trees are planted.

Some areas of this soil are in Wilderness Park. This area of former cropland is being planted to trees and grass to improve wildlife habitat. Deer, quail, squirrels, and cottontail rabbits live in wooded areas. Mink, muskrat, beaver, and other furbearers inhabit wet areas. Carp, bullheads, and catfish are in nearby streams.

Wetness is a hazard for such recreation activities as camping and picnicking. Sites should be placed on the nearby Kennebec soil because flooding and wetness in the Kennebec soil are less extensive than in this Zook soil.

This soil is not suited to building sites, septic tank absorption fields, and sewage lagoons because of wetness, slow permeability, and flooding. Artificial drainage and elevated roadbeds reduce the hazards of wetness and flooding for roads.

This soil is in capability units IIw-2 dryland and IIw-2 irrigated. It is in Clayey Overflow range site and windbreak suitability group 2.

Zp—Zook silty clay loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on bottom lands, generally back from the stream channels. It is occasionally flooded. Areas are long and range from 10 to 400 acres.

Typically, the surface layer is silty clay loam about 26 inches thick. The upper part is very dark gray and friable, the middle part is black and friable, and the lower part is very dark gray and firm. The subsoil, to a depth of 60 inches, is silty clay. The upper part is very firm and black, and the lower part is firm and very dark gray. In places, the subsoil has a few fine soft accumulations of lime. Small areas of this soil contain less clay in the subsoil.

Included with this soil in mapping are small areas of moderately well drained Kennebec soils. These areas are closer to the stream channel than Zook soils and make up 5 to 15 percent of each map unit.

This Zook soil has slow permeability. Runoff is slow. Available water capacity is high, and content of organic matter is moderate. Natural fertility is high. The seasonal high water table ranges from 2 to 4 feet below the surface. Reaction of the surface layer is strongly acid. Shrink-swell potential of the subsoil is high.

Most of the acreage of this Zook soil is used for cultivated crops. The rest is mainly in native grass. The soil has good potential for common cultivated crops and for grass. It has good potential for wildlife habitat and poor potential for most engineering uses. The potential is fair for trees in windbreaks.

This soil is well suited to late planted grain sorghum, soybeans, wheat, and legumes. Lime is needed in places if legumes are grown. If this soil is drained, it is well suited to corn. Proper placement of rows, land grading, and installation of tile drains improve drainage. Outlets are generally available. This soil dries slowly in spring and during rainy periods, and tillage is commonly delayed. The surface tends to puddle and become cloddy and hard if it is worked when wet. Plowing in fall permits earlier field work in spring and allows freezing and thawing to improve the tilth. Crops respond fairly well to applications of fertilizer if the drainage is adequate. This soil is suited to gravity and sprinkler irrigation systems. The increase in yield over dryfarm production may not be high during seasons when rainfall is normal, but it can be significant if precipitation is low.

Reed canarygrass grows well in tame grass pasture. Alsike clover, Ladino clover, or birdsfoot trefoil can be included in the planting system.

The kind of native grass that grows on this soil is determined by the periodic flooding and by slow permeability. A planned grazing system that includes both native grass range and tame grass pasture is desirable. The potential is good for native hay.

This soil provides good sites for tree windbreaks. Chances of survival and growth are good if the selected trees are tolerant of occasional wetness. Establishing seedlings is a concern in wet years. Although black walnut trees are not planted in windbreaks, they are well suited to this soil.

The amount of food and cover available for wildlife is reduced because this soil is commonly intensively cropped. However, pheasants feed on grain left after harvesting, and deer find food and cover in the nearby wooded areas along streams. Wildlife habitat is improved if shrubs are planted.

A few large dams have been constructed on this soil, and the water in reservoirs now covers several hundred acres. These lakes provide fishing, boating, and swimming. Areas adjacent to the lakes have picnic and camping sites. However, this soil is often wet in the spring, and recreation areas should be placed on better drained soils.

This soil is generally not suited to building sites, septic tank absorption fields, or sewage lagoons because of wetness, flooding, and slow permeability. Roadbeds need to be elevated and drainage provided to reduce soil wetness.

This soil is in capability units IIw-4 dryland and IIw-1 irrigated. It is in Clayey Overflow range site and windbreak suitability group 2.

Use and management of the soils

This survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land use.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as windbreaks and environmental plantings; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, lawns, and trees and shrubs.

Crops and pasture

Prepared by William E. Reinsch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Most of the farmland in Lancaster County is under cultivation. According to the Nebraska Agriculture Statistics of 1976, 80 percent of the acreage in farms is planted to cultivated crops. The largest acreage is in sorghum and wheat, followed by corn, soybeans, alfalfa hay, and oats. About 40 percent of the 18,000 acres of irrigated soils is used for corn.

The soils of Lancaster County are well suited to cultivated crops if they are well managed. The Sharpsburg and Wymore soils make up the majority of the acreage used for cropland in the county.

Management of dryfarmed cropland

Good management practices on dryfarmed cropland reduce runoff and risk of erosion, conserve moisture, and improve tilth. Most of the soils in Lancaster County are suitable for the production of crops. In many places, however, the severe erosion hazard needs to be reduced or corrected by suitable conservation practices.

Water erosion is a major problem on about 75 percent of the acreage that has potential as cropland. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced when the surface layer is lost and part of the subsoil is incorporated into the plow layer. Second, the sediment produced from erosion is a pollutant to streams. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, for example, Crete, Wymore, and Pawnee soils. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal and recreation uses and for fish and wildlife.

The overall hazard of erosion can be reduced if the more productive soils are used for row crops and steeper, more erosive soils are used for such close growing crops as wheat, rye, alfalfa, or hay and pasture. Proper use can reduce the hazard of erosion in many areas. Under dryland management, the kind and the amount of fertilizer to be applied should be based on results of soil tests and on the content of moisture in the soil at the

time of application. If the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than the rate applied if subsoil moisture is adequate. For nonlegume crops, the application of nitrogen fertilizer is beneficial in all soils. Application of phosphorus and zinc are needed on the more eroded soils or on areas that were excavated for construction of terraces or waterways. Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping sequence that keeps vegetative cover on the soil for extended periods can reduce soil erosion so that the productive capacity of the soil is not decreased.

In intensive cropping systems, crop residue is an important asset to water conservation, soil fertility, and erosion control. Standing crop stubble can be used to trap snow on the field and to limit water loss by evaporation. If crop residue is returned to the soil, it helps to maintain soil fertility and improve soil tilth for future crops. Two tons of crop residue per acre contain about 20 pounds of nitrogen, 10 pounds of available phosphate, and about 30 pounds of potash. Soil bulk density is reduced by returning crop stubble to the soil, and soil crusting problems and fuel requirements for tillage are reduced by less soil density. More importantly, crop residue left on the surface helps to control erosion.

The sequence of crops grown on a field, in combination with the practices needed for management and conservation of the soil, is known as a Resource Management System. On livestock farms, the Resource Management System includes grasses and legumes in the crop rotation and use of manure for improvement of soil fertility. These practices reduce water and wind erosion on land that has short and irregular slopes where contouring and terracing are not feasible. In addition, they supply plant nutrients and improve soil tilth. The practice of conservation tillage that leaves crop residue on the surface reduces water erosion and wind erosion. At least 1,500 pounds of row crop residue needs to be left on the surface to reduce erosion significantly.

On cropland, the Resource Management System should preserve tilth and fertility; maintain a plant cover that protects the soil from erosion; control weeds, insects, and diseases; and reduce runoff. Cropland resource management systems vary according to the soils on which they are used. For example, a resource management system for cropland on Pawnee clay loam, 7 to 11 percent slopes, eroded, should include a high percentage of grass and legume crops in the crop rotation, terraces, contour farming, and a conservation tillage system that leaves 2,000 pounds of crop residue on the surface after planting. In contrast, on Kennebec silt loam, 0 to 2 percent slopes, row crops can be grown on the soil continuously. If crop residue is left on the field through winter, applications of fertilizer and good management are sufficient to maintain the productive capacity of the Kennebec soil.

No-tillage or Till-plant when used for row crop production will effectively reduce erosion on sloping land. These tillage practices can be adapted to most soils in the survey area. Terraces and diversions reduce the length of slope and reduce runoff and erosion. These practices are most effective on deep, well drained soils that have regular slopes. Sharpsburg soils and Wymore soils are suitable for terraces and contour farming. Contour farming also improves the effectiveness of conservation tillage systems. Terraces, contour farming, grassed waterways, contour stripcropping, and conservation tillage systems are erosion control practices that can be used in Lancaster County. The hazard of wind erosion in Lancaster County is minor, but management practices similar to those that control water erosion can be used to control erosion by wind. Stubble mulching, conservation tillage, crop residue management, wind stripcropping, and narrow field windbreaks help to control wind erosion.

Management of irrigated cropland

Because the ground water supply is limited and irrigation is increasing in Lancaster County, future water needs will have to be met with project type developments. Sprinkler irrigation is the dominant method used where water is available. Corn is the primary irrigated crop. Gently sloping soils, for example, Sharpburg silty clay loam, 2 to 5 percent slopes, are subject to water erosion if they are irrigated and to wind erosion if they are fall plowed. Conservation practices similar to those that control water erosion on dryfarmed cropland apply to irrigated acreages. Terraces, contour farming, use of crop residue, and conservation tillage systems that leave a protective cover or crop residue on the surface after row crop plantings increase water intake of the soil, slow runoff, and reduce erosion. In addition, they improve the soil tilth.

Sprinkler irrigation can be used on the more sloping soils; however, conservation practices need to be applied to control soil erosion. Surface irrigation is suitable for gently sloping soils. If surface irrigation is used, land leveling increases efficiency of the system because water is evenly distributed. The efficiency of other methods of irrigation can be improved if tailwater recovery systems are added.

Contour bench leveling or contour furrow irrigation can be used on soils that have 2 to 6 percent slopes to conserve rainfall as well as irrigation water.

Maximum efficiency is obtained if irrigation is started when about one-half of the stored water has been used by the plants. For example, if a soil holds 8 inches of available water, irrigation should begin when about 4 inches of water has been removed by the crop. Irrigation sets or systems should be planned to replace the amount of water that has been used by the crop.

Management needs to control or regulate the application of irrigation water so that good crop growth is obtained without wasting soil or water. Furrow irrigation or surface irrigation is most efficient if maximum stream size

is used down each row and a tailwater recovery system catches the water for reuse. Center-pivot or sprinkler-type irrigation systems are more effective if small amounts of water are applied at frequent intervals. Irrigated soils generally produce higher yields than dryland soils. Consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed from the soil when crops are harvested. Return of all crop residue to the soil and additions of barnyard manure and commercial fertilizer help to supply needed plant nutrients. If soils have been disturbed during land leveling, and particularly if the topsoil has been removed, applications of phosphorus and zinc as well as nitrogen are desirable. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

All of the soil series suitable for irrigation in Nebraska are placed in an irrigation design group. These design groups are described in the Nebraska Irrigation Guide (*6*), which is part of the Technical Guide for conservation in Nebraska. Arabic numbers of irrigation capability units indicate the irrigation design group to which the soil belongs. Assistance in planning and design of an irrigation system is available at the local office of the Soil Conservation Service. Estimates concerning cost of equipment can be obtained from local dealers and manufacturers of irrigation equipment.

Management of pastureland and hayland

Areas in hay or tame pasture should be managed for maximum production. Once the pasture is established, the grasses need to remain productive. A rotation grazing system that meets the needs of the plants and promotes uniform use of the forage is important for high production (fig. 15). Many forages are a good source of minerals, vitamins, proteins, and other nutrients. During the growing season, well managed pasture can provide a balanced ration to livestock. Irrigated pastures require a higher level of management than dryland pastures if they are to produce at capacity.

A mixture of grasses and legumes can be grown on many kinds of soils, and with proper management the pasture will return a fair profit. This kind of mixture is

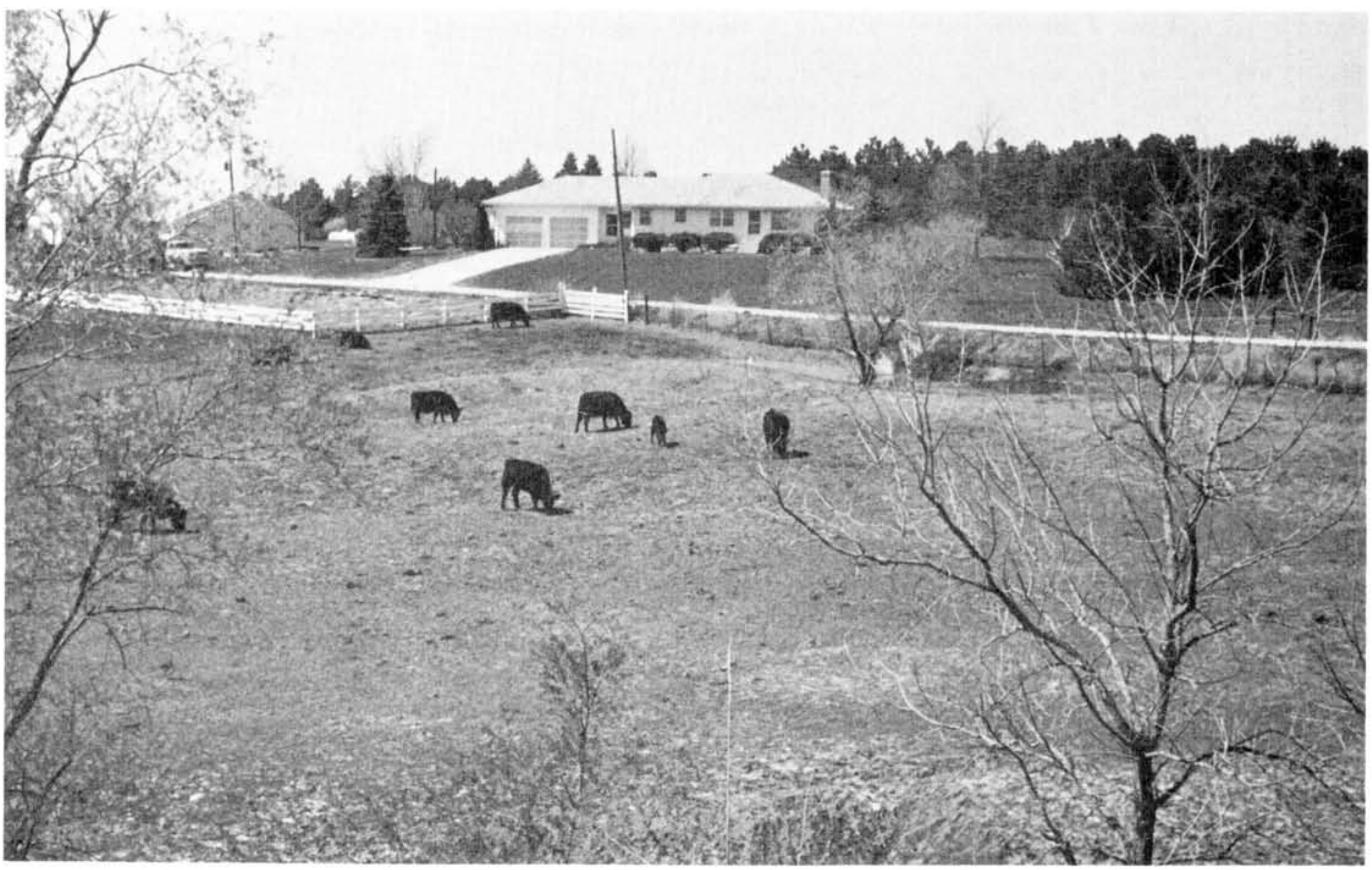


Figure 15.—This mixture of introduced grasses provides grazing throughout most of the year. Pasture grasses are excellent for rotation in a good conservation cropping system.

compatible with grain crops in a crop rotation, and has beneficial soil-building effects because grasses and legumes help to improve soil tilth, add to the content of organic matter, and reduce erosion. Such a crop rotation program is ideal for use in a conservation cropping system.

Pasture and hay, both dryland and irrigated, require additional plant nutrients for maximum production. The kinds and amounts of fertilizer needed should be determined by soil tests.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous. Such conservation practices as a cropping sequence with legumes and grasses in the rotation, a conservation tillage system, and use of crop residue improve soil tilth.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit re enough alike to be suited to

the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-4.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland makes up about 5 percent of the farmland in Lancaster County. It is mainly in the western part of the county in the Steinauer-Pawnee-Burchard and the Sharpsburg-Pawnee-Burchard soil associations. Most of the rangeland is in the Clayey, Silty, and Limy Upland range sites. The rest is in Subirrigated, Saline Subirrigated, Silty Overflow, Clayey Overflow, Silty Lowland, Saline Lowland, Sandy, Shallow Limy, Shallow Sandy, and Dense Clay range sites. Livestock farms and ranches average about 480 acres.

The raising of livestock, mainly cow and calf herds, is the second largest farm industry in Lancaster County. The calves are sold in the fall as feeders . The range is generally grazed from late in spring to early in fall. The rest of the year the cattle graze smooth bromegrass in spring and grain sorghum or corn aftermath in fall and early in winter. They are fed alfalfa or native hay, silage, or both kinds of forage the rest of the winter.

In some areas of the county, the range has been depleted through overuse and is invaded by low forage producing grasses and broadleaf weeds. The productivity of the range can be increased if sound management practices are used, for example, proper grazing use, deferment of grazing, and a planned grazing system. In addition, range seeding (fig. 16) can be used on cropland where soil loss has exceeded acceptable limits.

At the end of each map unit description in this survey, the soil is placed in an appropriate range site rated according to the kind and amount of vegetation grown on the soil when the site is in climax condition. The interpretations for each range site in the county are in the technical guide which is in the local office of the Soil Conservation Service. Farmers who need technical help with seeding cropped land to grass or with setting up a

Figure 16.—Range seeding consisting of big bluestem, little bluestem, indiangrass, switchgrass, sideoats grama, and sand lovegrass in an area of Burchard and Steinauer soils.

planned grazing system, or who want other information about a range program can obtain help from the local office of the Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Most of the woodland in Lancaster County is along the major streams and their principal tributaries. Farm woodlots, which are generally small, make up about 1 percent of the county. Although these wooded areas are capable of producing commerical wood products, their esthetic properties and their importance as wildlife habitat and watershed protection are of more value.

Black walnut, bur oak, eastern cottonwood, green ash, common hackberry, and silver maple are the trees most commonly used for wood products. Black willow, boxelder, American elm, slippery elm, honeylocust, northern catalpa, and red mulberry also grow in Lancaster County.

In many woodlots, the best trees have been cut for lumber, posts, poles, and firewood and the rest of the woodland is left standing in depleted condition. These woods can be improved if trees are protected from grazing, if undesirable trees or undesirable species are removed, and if inadequate stands are replanted.

Windbreaks

Prepared by John Brubacher, assistant State soil scientist, and James W. Carr, forester, Soil Conservation Service.

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 17). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low growing and high growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

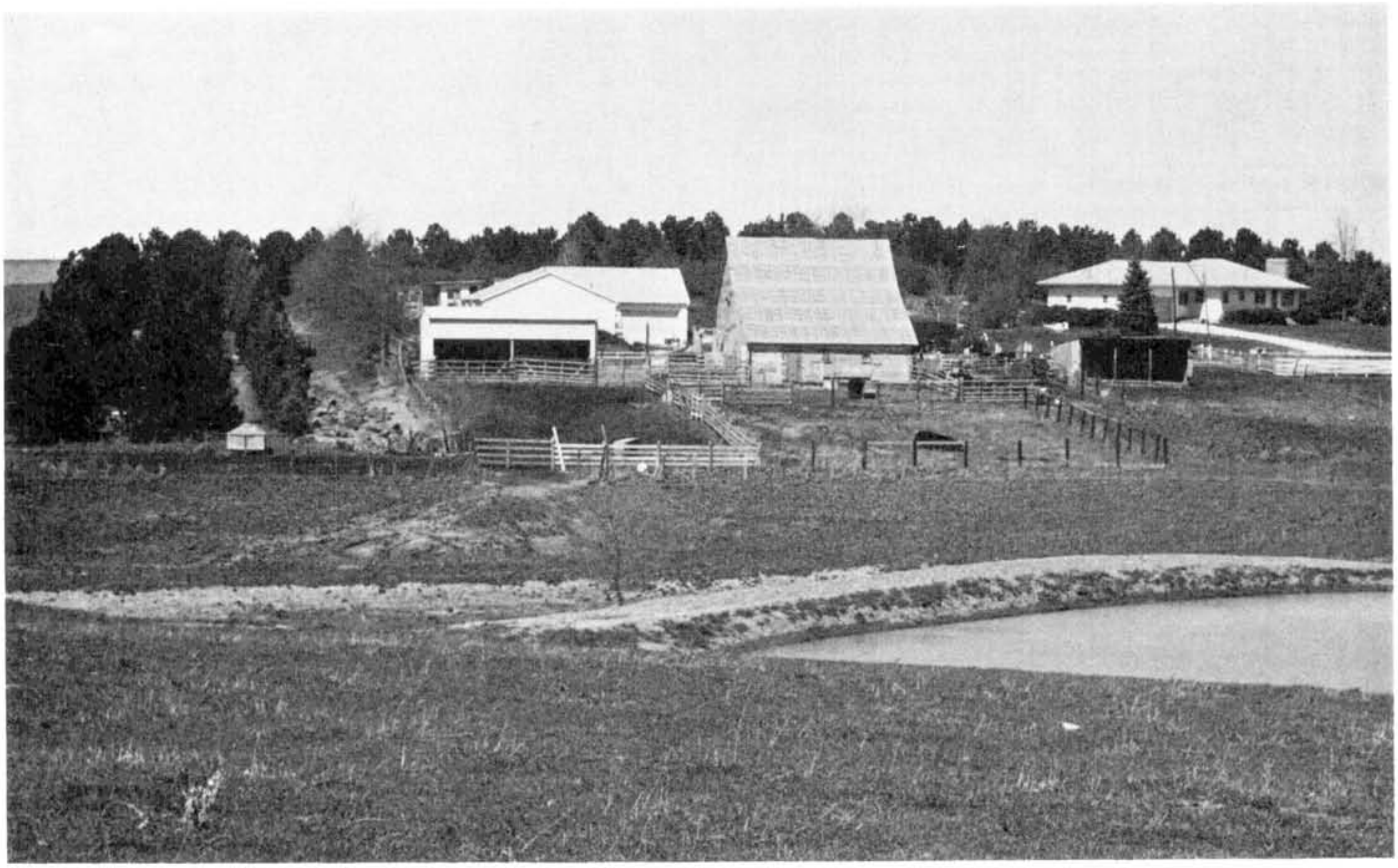


Figure 17.—This farmstead on Sharpsburg silty clay loam is protected on the north and west by an excellent windbreak.

A well designed windbreak fits the soil in which it is to grow and serves the purpose of planting. Trees and shrubs are not easily established every year; however, chances of survival are high if good tree culture is observed.

The rate of growth in a windbreak varies according to the content of soil moisture and the degree of soil fertility. Exposure and arrangement of trees within the planting also have a considerable effect on tree growth. Some species grow more quickly than others. Some trees, for example, eastern cottonwood, occasionally produce an early, fast growth but tend to die young. Siberian elm and Russian olive grow vigorously, but these trees spread where they are not wanted and are sometimes short lived. Boxelder and Russian mulberry commonly freeze back in severe winters. Green ash is susceptible to damage by borers.

Cedar and pine trees are better fitted for windbreaks than other trees. These conifers rate high in vigor and survival. In addition, they hold their leaves through the winter to afford maximum protection when it is needed.

On most soils in Lancaster County, weeds and undesirable grasses can be controlled by cultivating between the rows with conventional equipment such as a disc. Hand hoeing or careful use of a herbicide can control undesirable vegetation within the row.

Newly planted trees and seedlings sometimes need watering to become well established. Larger trees can also need supplemental water if the natural precipitation is low, or if the soil is droughty.

At the end of each map unit description in this survey, the soil is placed in a windbreak suitability group, based primarily on adaptability of the species as indicated by growth and vigor. Interpretations for each windbreak suitability group in the county are in the technical guide which is in the local office of the Soil Conservation Service. Farmers or landowners who need technical help in establishing and managing a windbreak, or who want other information about planting trees and shrubs, can obtain help from the Soil Conservation Service.

Selection of plants for environmental plantings

Prepared by James W. Carr, Jr. and Keith A. Ticknor, foresters, and John I. Brubacher, assistant State soil scientist, Soil Conservation Service.

Trees, grasses, shrubs, and other plants are used to control erosion, reduce sediment, supply shade along streets and in parks, beautify lawns and homes, provide privacy, reduce noise, or landscape the open space around factories, apartment houses, and school buildings.

Table 9 is a general guide for environmental plantings. It indicates species of plants adapted to the soils of Lancaster County.

Color of foliage, flowering and fruiting characteristics, growth habits of plants, and susceptibility to disease are considered in table 9. Many horticultural varieties that are well adapted to the climate of Lancaster County are not named in the table. Information about horticultural plants is generally available from local nurserymen.

American elm, which grows in many different soils in the county and was formerly used extensively as a shade tree, is not listed in table 9 because it is susceptible to Dutch elm disease.

Growth habits, shade tolerance, erosion control value, and esthetic features determine the suitability and use of plants for various purposes and in various locations. Most plants can be used for more than one purpose if suitable plants are selected. For example, some plants that have colorful foliage or fruit and are used for hedges, screens, erosion control, or beautification of the landscape are also of value as wildlife habitat.

Recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

The chain of Salt Valley lakes makes up a land area of 8,865 acres and a water area of 3,990 acres. It includes the Bluestem, Conestoga, Olive Creek, Pawnee, Stagecoach, Yankee Hill, Branches Oak, Wagon Train, Hedgefield, Teal, and Killdeer Lakes, and supplies the major picnicking, camping, fishing, boating, and swimming sites in Lancaster County. These lakes are maintained by the Nebraska Game and Parks Commission and are accessible to the public. Some small PL-566 watershed structures also can be used for recreation (fig. 18).

Pheasants, bobwhite quail, mourning doves, and migratory waterfowl inhabit the area around these lakes and ponds, and they are commonly hunted. Deer are hunted in the wooded areas along streams during the hunting season.

Holmes Lake in the city of Lincoln supplies fishing, boating, picnicking, swimming, bicycling, and hiking facilities to residents of Lincoln and surrounding areas. It is maintained by the Lincoln Parks and Recreation Department. In addition, Wilderness Park and other Lincoln city parks are used for recreation purposes.

Figure 18.—This watershed reservoir provides facilities for recreation as well as flood control.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife habitat

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, bromegrass, orchardgrass, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil proper-

ties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, switchgrass, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, cottonwood, ash, sweetgum, willow, and Russian mulberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, honeysuckle, and Peking cotoneaster.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of native coniferous plants are ponderosa pine and eastern redcedar. Examples of coniferous plants that are commercially available and suited to soils in Lancaster County are Austrian pine and Scotch pine.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are silver buffaloberry, plum, chokeberry, and skunkbush sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasants, meadowlarks, field sparrows, cottontails, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include thrushes, woodpeckers, squirrels, red fox, raccoon, deer, and opossum.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include white-tailed deer, badger, and meadowlark.

The eight soil associations in Lancaster County and the wildlife that live there are described in the following paragraphs.

The Sharpsburg-Pawnee-Burchard and the Sharpsburg-Judson associations are made up of rolling hills and grassed waterways, and are used by openland wildlife. Grain sorghum and wheat provide food and cover for pheasants and bobwhite quail. The steeper areas are in pastureland and rangeland. These areas provide nesting cover for upland game birds. Because irrigation is not common in these associations, wildlife has to travel to the streams for water. Scattered clumps of plum, chokecherry, mulberry, and ash are on the hillsides, along fence rows, and in drainageways. These trees and shrubs add variety to the landscape, and supply nesting sites for songbirds and mourning doves. Roadside ditches provide travel lanes for many kinds of wildlife and nesting sites for pheasants and bobwhite quail.

The Kennebec-Nodaway-Zook association is in bottom lands adjacent to the main drainageways. It has the most diverse cover in the county. These heavily wooded areas provide cover for white-tailed deer, tree squirrels, raccoon, opossum, mourning doves, and many songbirds and predatory hawks and owls. The frequently flooded Colo and Nodaway soils are in this association. Flooded areas provide grass, trees, and shrubs for wildlife. Many springs and ponds in this association supply water to all kinds of wildlife.

The Crete-Sharpsburg, Pawnee-Burchard, and the Steinauer-Pawnee-Burchard associations are adjacent to bottom lands and streams and are used by openland wildlife. Travel lanes from the streams to the uplands occur in these associations, and woodland wildlife as well as openland wildlife travel these lanes for food (fig. 19).

The Wymore-Pawnee and the Crete-Wymore-Butler associations are used by openland wildlife, chiefly pheasants. Bobwhite quail inhabit the areas that are interspersed with woodland and grassland. Mourning doves are common, especially where open water is present. Farmstead windbreaks, fence lines, and grassed waterways provide cover, crops supply food, and many small ponds and springs in this association provide water for wildlife.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most

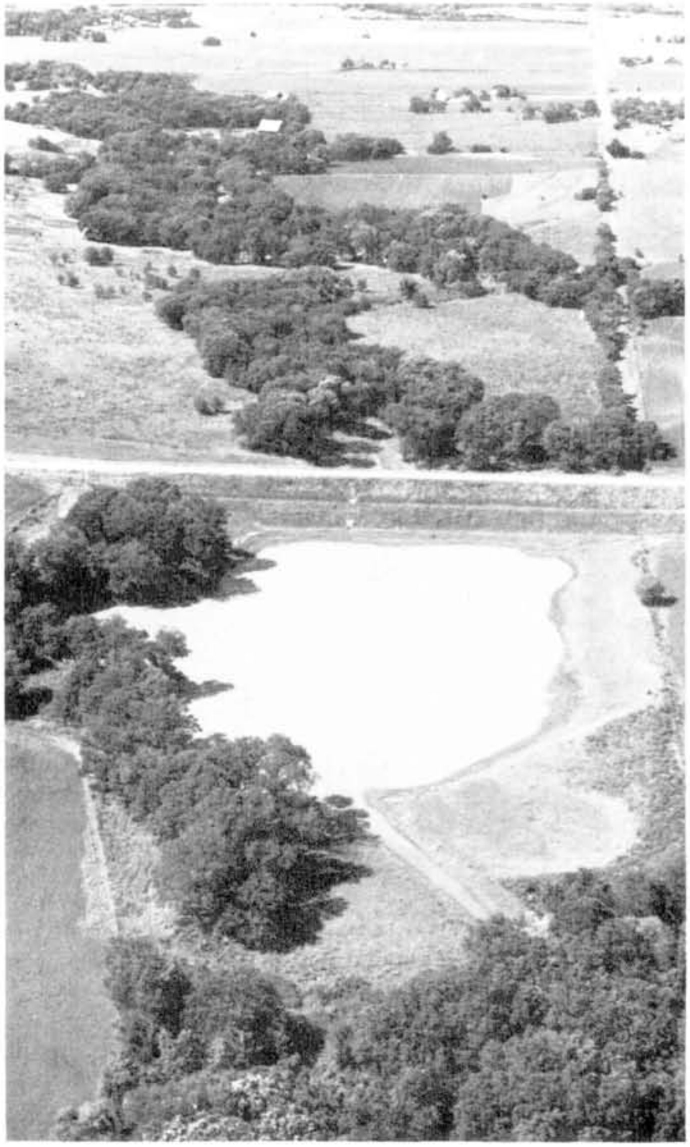


Figure 19.—Native woodland along this intermittent stream in the Steinauer-Pawnee-Burchard association provides good habitat and travel lanes for woodland and openland wildlife.

limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance

is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface (fig. 20). Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential,

Figure 20.—Stability of the soil is important in the design and construction of roads and highways. Cloverleaf interchange is I-80 and I-180 at the northwest edge of Lincoln.

frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are

free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill, topsoil, and sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 14 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 16.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 15 gives information on the soil properties and site features that affect water management. It also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27

percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in

place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K in this survey area range from 0.20 to 0.43. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare,

common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering index test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM).

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudolls (*Argi*, meaning developed horizonation, plus *udoll*, the suborder of the Mollisols that have a humid moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine montmorillonitic, mixed, mesic Typic Argiudolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*7*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Burchard series

The Burchard series consists of deep, well drained soils on uplands. Permeability is moderately slow. The soils formed in calcareous Kansan till. Slope ranges from 6 to 30 percent.

Burchard soils are similar to Pawnee, Shelby, and Steinauer soils and are commonly adjacent to Mayberry soils. Pawnee, Shelby, and Mayberry soils are moderately well drained. Pawnee and Mayberry soils have more clay in the B horizon than Burchard soils. Mayberry soils formed in material reworked from Kansas till. Steinauer soils have carbonates at a higher level in the profile and have a thinner dark surface layer than Burchard soils.

Typical pedon of Burchard clay loam, 6 to 11 percent slopes, 400 feet south and 2,000 feet east of northwest corner sec. 29, T. 7 N., R. 6 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine and medium granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

B21t—8 to 11 inches; 60 percent dark brown (10YR 3/3) and 40 percent very dark grayish brown (10YR 3/2) clay loam, dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, firm; medium acid; clear smooth boundary.

B22t—11 to 22 inches; brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear wavy boundary.

B3ca—22 to 33 inches; grayish brown (2.5Y 5/2) clay loam; light brownish gray (10YR 6/2) dry; many

medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; many large soft accumulations of segregated carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; hard, firm; many small soft accumulations of segregated carbonates; violent effervescence; moderately alkaline.

The solum ranges from 24 to 45 inches in thickness. The mollic epipedon is 8 to 20 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is dominantly clay loam, but the range includes loam. Reaction ranges from medium acid to neutral. The B22t horizon has value of 3 through 5 (4 through 6 dry) and chroma of 3 through 6. Reaction ranges from neutral to moderately alkaline. The C horizon has value of 5 or 6 (6 or 7 dry) and chroma of 2. It has few to many, fine to large, yellowish brown mottles. The depth to carbonates ranges from 13 to 30 inches.

Butler series

The Butler series consists of deep, somewhat poorly drained soils on loess covered uplands or stream terraces. Permeability is slow. The soils formed in loess. Slope ranges from 0 to 1 percent.

Butler soils are similar to Fillmore soils and are commonly adjacent to Crete and Wymore soils. Fillmore soils have a thicker A2 horizon than Butler soils. Crete and Wymore soils do not have an abrupt boundary between the A and B horizons.

Typical pedon of Butler silt loam, 0 to 1 percent slopes, 1,260 feet south and 2,500 feet west of northeast corner sec. 35, T. 7 N., R. 6 E.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—6 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; medium acid; abrupt smooth boundary.

A2—10 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak medium platy structure parting to weak fine granular; slightly hard, very friable; medium acid; abrupt smooth boundary.

B21t—12 to 25 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong medium prismatic structure parting to strong medium blocky; very hard, very firm; slightly acid; gradual smooth boundary.

B22t—25 to 34 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; strong medium prismatic structure parting to strong medium blocky; very hard, very firm; neutral; gradual smooth boundary.

B3—34 to 43 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few small iron-manganese concretions; strong effervescence; many small lime concretions; mildly alkaline; gradual smooth boundary.

C—43 to 60 inches; olive (5Y 5/3) silty clay loam, pale yellow (5Y 7/3) dry; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; slightly hard, friable; few small soft very dark brown masses (iron-manganese); strong effervescence; many small lime concretions; mildly alkaline.

The solum ranges from 35 to 50 inches in thickness. The depth to carbonates ranges from 26 to 45 inches.

The A1 horizon has value of 2 or 3 (4 or 5 dry) and chroma of 1 or 2. The A2 horizon has value of 3 to 5 (4 through 6 dry) and chroma of 1. Reaction ranges from slightly acid to mildly alkaline. In some pedons, the A2 horizon is absent. The B2t horizon is silty clay or clay and averages between 45 and 55 percent content of clay. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 or 3.

Colo series

The Colo series consists of deep, somewhat poorly drained or poorly drained soils that formed in alluvium. Permeability is moderately slow. The soils occur on occasionally or frequently flooded bottom lands. Slope ranges from 0 to 2 percent.

Colo soils are similar to and are commonly adjacent to Judson, Kennebec, Nodaway, Lamo, and Zook soils. Kennebec, Judson, and Nodaway soils are better drained than Colo soils. Lamo soils are calcareous. Zook soils have more clay in the 10 to 40 inch control section than Colo soils.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, 114 feet north and 2,100 feet east of southwest corner sec. 29, T. 10 N., R. 8 E.

Ap—O to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable, hard; medium acid; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable, slightly hard; medium acid; clear smooth boundary.

A13—12 to 36 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to weak fine granular;

friable, slightly hard; medium acid; gradual smooth boundary.

C—36 to 60 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; massive; friable, slightly hard; slightly acid.

The mollic epipedon is more than 36 inches thick. It is typically silty clay loam, but the range includes silt loam. The surface layer is neutral to medium acid.

Some pedons have an AC horizon which is 10 to 14 inches thick. Strata of dark gray, dark grayish brown, or grayish brown overwash sediment as much as 18 inches thick occur in some pedons.

The Colo soils in Colo-Nodaway silty clay loams, 0 to 2 percent slopes, have fine strata in the upper part of the profile which are not definitive for the Colo series, but this difference does not alter the usefulness or behavior of the soils.

Crete series

The Crete series consists of deep, moderately well drained soils on uplands and stream terraces. Permeability is slow. The soils formed in loess. Slope ranges from 0 to 6 percent.

Crete soils are commonly adjacent to Butler, Sharpsburg, and Wymore soils. Butler soils are somewhat poorly drained and have an abrupt boundary between the A and B horizons. Sharpsburg soils contain less clay in the B2t horizon than Crete soils. Wymore soils have a thinner mollic epipedon.

Typical pedon of Crete silt loam, 0 to 2 percent slopes, 135 feet west and 1,640 feet north of southeast corner sec. 32, T. 7 N., R. 5 E.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; medium acid; clear smooth boundary.

B1t—13 to 20 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; some black (10YR 2/1) channel filling; slightly acid; clear wavy boundary.

B21t—20 to 26 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; some black (10YR 2/1) channel filling; slightly acid; gradual wavy boundary.

B22t—26 to 31 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; neutral; clear wavy boundary.

B3—31 to 39 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; common fine distinct strong brown (7.5YR 5/6) mottles; medium prismatic structure parting to weak medium subangular blocky; hard, firm; common small lime concretions; mildly alkaline; gradual wavy boundary.

C1—39 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; slightly hard, friable; common small lime concretions; few small soft very dark brown masses (iron-manganese); mildly alkaline; clear wavy boundary.

C2—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; many large distinct yellowish red (5YR 4/6) mottles; weak coarse prismatic structure; slightly hard; few small soft accumulations of carbonates; common small soft very dark brown masses (iron-manganese); mildly alkaline.

The solum ranges from 36 to 50 inches in thickness. The mollic epipedon ranges from 20 to 34 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is silt loam or silty clay loam. Reaction is medium acid or slightly acid. The upper part of the B2t horizon has hue of 10YR, value of 3 (4 or 5 dry), and chroma of 2 or 3. It is silty clay that averages between 45 and 50 percent content of clay. The upper part of the B2t horizon has slightly more clay than the lower part. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (6 or 7 dry), and chroma of 2 through 4. It is generally silty clay loam, but the range includes silt loam. In places, carbonates are absent to a depth of 5 feet.

Crete Variant

The Crete Variant consists of deep, moderately well drained soils on stream terraces and uplands. Because the saline-alkali characteristic is not typical of the Crete series, these soils are designated Crete Variant. Permeability is slow. The soils formed in loess. Slope ranges from 1 to 4 percent.

Soils in the Crete Variant are commonly adjacent to Butler, Crete, and Sharpsburg soils. Butler, Crete, and Sharpsburg soils have less soluble salts and exchangeable sodium in the B2t horizon than Crete Variant soils.

Typical pedon of Crete Variant silty clay loam, 1 to 4 percent slopes, 100 feet south and 2,300 feet east of northwest corner sec. 5, T. 11 N., R. 8 E.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; hard, friable; 0.03 percent soluble salts; slightly acid; abrupt smooth boundary.

B1t—6 to 12 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; hard, firm; 0.05 percent soluble salts; mildly alkaline; clear wavy boundary.

B2t—12 to 20 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; some small lime concretions; 0.21 percent soluble salts; strongly alkaline; clear wavy boundary.

B3—20 to 25 inches; grayish brown (10YR 5/2) silty clay loam, pale brown (10YR 6/3) dry; few fine distinct gray (5YR 5/1) mottles; weak medium prismatic structure; hard, friable; some small lime concretions; 0.13 percent soluble salts; strongly alkaline; gradual wavy boundary.

C—25 to 60 inches; brown (10YR 5/3) silty clay loam, very pale brown (10YR 7/3) dry; few fine distinct gray (5YR 5/1) mottles; massive; hard, friable; some small lime concretions; 0.08 percent soluble salts; very strongly alkaline.

The solum ranges from 20 to 36 inches in thickness. The mollic epipedon ranges from 7 to 18 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. The B2t horizon has value of 4 or 5 (5 or 6 dry) and chroma of 2 or 3. It is silty clay that averages between 45 and 50 percent content of clay. Electrical conductivity of the saturation extract ranges from 4 to 12. Sodium adsorption ratio is more than 13. Reaction ranges from mildly alkaline to strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (6 or 7 dry), and chroma of 2 through 4.

Dickinson series

The Dickinson series consists of deep, somewhat excessively drained soils on uplands. Permeability is moderately rapid. The soils formed in glacial outwash that was reworked or redeposited by wind and water. Slope ranges from 6 to 11 percent.

Dickinson soils are similar to Morrill soils, and are commonly adjacent to Burchard, Hedville, Malcolm, and Steinauer soils. Hedville soils are shallow over sandstone. Morrill, Burchard, and Steinauer soils have more clay in their control sections than Dickinson soils. Burchard and Steinauer soils developed on Kansan till. The coarse, silty Malcolm soils formed in lacustrine silt.

Typical pedon of Dickinson fine sandy loam, 6 to 11 percent slopes, 1,700 feet south and 450 feet west of northeast corner sec. 28, T. 9 E., R. 5 E.

Ap—0 to 6 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine and medium granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A3—6 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak fine and medium subangular blocky structure; slightly hard, very friable; medium acid; clear wavy boundary.

B2—12 to 23 inches; dark yellowish brown (10YR 4/4) fine sandy loam, dark yellowish brown (10YR 5/4) dry; weak fine and medium subangular blocky structure; soft, very friable; medium acid; clear wavy boundary.

B3—23 to 30 inches; yellowish brown (10YR 5/6) fine sandy loam, brownish yellow (10YR 6/6) dry; very weak medium subangular blocky structure; soft, very friable; medium acid; gradual wavy boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand; very pale brown (10YR 7/4) dry; single grain; loose; medium acid.

The solum ranges from 24 to 45 inches in thickness. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes sandy loam and loam. The B2 horizon has value of 3 through 5 (5 or 6 dry) and chroma of 3 through 6. It is sandy loam or fine sandy loam. The B3 horizon and the C horizon have value of 4 or 5 (5 through 7 dry) and chroma 3 through 6. The B3 horizon is sandy loam, fine sandy loam, or loamy fine sand. The C horizon is generally loamy fine sand, but the range includes loamy sand, fine sand, and sand.

In Dickinson fine sandy loam, 6 to 11 percent slopes, eroded, the surface layer is thinner than is defined for the Dickinson series.

Fillmore series

The Fillmore series consists of deep, poorly drained soils on loess covered uplands and stream terraces. Permeability is very slow. The soils formed in loess. They are in shallow depressional areas, or basins, and are occasionally flooded by water from adjacent higher areas. Slope ranges from 0 to 1 percent.

Fillmore soils are commonly adjacent to Butler and Crete soils. Butler soils do not have an albic horizon. Crete soils are better drained than Fillmore soils, and they do not have an A2 horizon or an abrupt boundary between the A and B horizons.

Typical pedon of Fillmore silt loam, 0 to 1 percent slopes, 300 feet east and 2,110 feet north of southwest corner sec. 36, T. 7 N., R. 6 E.

Ap—0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A12—6 to 11 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak medium granular; slightly hard, friable; medium acid; clear smooth boundary.

A2—11 to 16 inches; gray (10YR 5/1) silt loam, light gray (10YR 6/1) dry; common fine distinct brown (7.5YR 4/4) mottles; weak medium platy structure parting to weak medium granular; slightly hard, very friable; medium acid; abrupt smooth boundary.

B21t—16 to 28 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; common fine distinct brown (7.5YR 4/4) mottles; moderate coarse and medium blocky structure; very hard, very firm; slightly acid; gradual smooth boundary.

B22t—28 to 39 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong medium prismatic structure parting to strong coarse blocky; very hard, very firm; neutral; gradual smooth boundary.

B3—39 to 48 inches; dark grayish brown (10YR 4/2) silty clay; grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; neutral; gradual smooth boundary.

C—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; hard, firm; few medium lime concretions; few medium pipestem iron concretions; neutral.

The solum ranges from 36 to 60 inches in thickness. The A2 horizon is 2 to 8 inches thick.

The A1 horizon has value of 2 or 3 (4 or 5 dry) and chroma of 1 or 2. Reaction is medium acid or slightly acid. The A2 horizon has value of 4 or 5 (5 through 7 dry) and chroma of 1. The B2t horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is silty clay that averages between 45 and 55 percent content of clay. The C horizon has value of 5 or 6 (5 through 7 dry) and chroma of 2 or 3.

Geary series

The Geary series consists of deep, well drained soils on loess covered uplands of Loveland age material. Permeability is moderately slow. Slope ranges from 6 to 11 percent.

Geary soils are commonly adjacent to Mayberry, Morrill, and Sharpsburg soils. Morrill soils have more sand and less silt than Geary soils. Mayberry soils have more clay in the B horizon. Sharpsburg soils are clayey and formed in Peorian Loess.

Typical pedon of Geary silty clay loam, 6 to 11 percent slopes, 50 feet south and 1,580 feet west of northeast corner sec. 3, T. 12 N., R. 7 E.

A1—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

B1—7 to 12 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; medium acid; clear smooth boundary.

B21t—12 to 19 inches; dark brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; medium acid; clear smooth boundary.

B22t—19 to 29 inches; dark brown (7.5YR 4/4) silty clay loam, strong brown (7.5YR 5/6) dry; moderate coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, firm; slightly acid; clear smooth boundary.

B3—29 to 37 inches; dark brown (10YR 4/4) clay loam, strong brown (7.5YR 5/6) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; slightly acid; gradual smooth boundary.

C1—37 to 60 inches; dark brown (7.5YR 4/4) clay loam, strong brown (7.5YR 5/6) dry; weak coarse prismatic structure; hard, firm; slightly acid.

The solum ranges from 30 to 60 inches in thickness. It is slightly acid or medium acid. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 2 or 3. The B2t horizon has hue of 7.5YR or 5YR, value of 3 through 5 (4 through 6 dry), and chroma of 3 through 6. It is typically silty clay loam or less commonly clay loam that averages 27 to 35 percent content of clay. The B3 horizon and C horizon have hue of 10YR, 7.5YR, or 5YR, value of 4 or 5 (5 through 7 dry), and chroma of 4 through 6. They are typically clay loam, but in places they are silty clay loam. In some areas, the C horizon is calcareous below a depth of 40 inches.

In Geary silty clay loam, 6 to 11 percent slopes, eroded, the surface layer is thinner than is defined for the Geary series.

Hedville series

The Hedville series consists of shallow, somewhat excessively drained soils on uplands. The soils formed in material weathered from sandstone. Slope ranges from 6 to 30 percent.

Hedville soils are commonly adjacent to Dickinson and Morrill soils. The Dickinson and Morrill soils are on side slopes above Hedville soils. They are deep and have a B horizon.

Typical pedon of Hedville sandy loam, 6 to 30 percent slopes, 100 feet south and 1,160 feet west of northeast corner sec. 34, T. 12 N., R. 8 E.

A11—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

A12—7 to 11 inches; dark brown (10YR 3/3) angular cobbly sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

C—11 to 16 inches; strong brown (7.5YR 5/6) loamy sand, reddish yellow (7.5 6/6) dry; weak medium granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

R—16 inches; yellowish brown, partially weathered sandstone.

The mollic epipedon ranges from 4 to 18 inches in thickness and corresponds to the thickness of the solum.

The A horizon is 6 to 15 inches thick. It has value of 2 or 3 (4 or 5 dry) and chroma of 1 through 3. The A horizon is dominantly sandy loam, but the range includes fine sandy loam and loam. Depth to sandstone bedrock ranges from 10 to 20 inches.

Judson series

The Judson series consists of deep, moderately well drained soils on colluvial foot slopes. Permeability is moderate. The soils mostly formed in noncalcareous, colluvial silty sediment, from the dark upland soils. Slope ranges from 2 to 6 percent.

Judson soils are commonly adjacent to Kennebec, Nodaway, Sharpsburg, and Wymore soils. Kennebec and Nodaway soils do not have a B horizon. Nodaway soils are stratified. Sharpsburg and Wymore soils have a thinner A horizon than Judson soils, and they have more clay in the B2 horizon.

Typical pedon of Judson silt loam, 2 to 6 percent slopes, 100 feet south and 1,000 feet east of northwest corner sec. 28, T. 9 N., R. 8 E.

Ap—0 to 6 inches, very dark brown (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A12—6 to 14 inches; black (10YR 2/2) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard, friable; medium acid; gradual smooth boundary.

A13—14 to 25 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak medium granular structure; slightly hard, friable; medium acid; gradual smooth boundary.

A3—25 to 29 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, friable; medium acid; clear smooth boundary.

B2—29 to 42 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, firm; medium acid; gradual smooth boundary.

B3—42 to 55 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak medium prismatic structure; hard, firm; medium acid; gradual smooth boundary.

C—55 to 60 inches; brown (10YR 5/3) silty clay loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable; slightly acid.

The solum ranges from 40 to 60 inches in thickness, and the depth to free carbonates is below 60 inches.

The A horizon is 24 to 36 inches thick. It has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is silt loam or silty clay loam. Reaction is strongly acid or medium acid. The B2 horizon has value of 3 through 5 (4 through 6 dry) and chroma of 2 or 3. Reaction is medium acid or slightly acid. The B3 horizon and C horizon have value of 4 through 6 (5 through 7 dry) and chroma of 3 or 4. In places, dark yellowish brown or yellowish brown mottles are in the B3 horizon or C horizon.

In Judson fine sandy loam, 2 to 6 percent slopes, the surface layer is thinner and contains more sand than is defined for the Judson series.

Kennebec series

The Kennebec series consists of deep, moderately well drained soils. Permeability is moderate. The soils formed in alluvium on bottom lands. Slope ranges from 0 to 2 percent.

Kennebec soils are similar to and adjacent to Colo, Judson, Nodaway, and Zook soils. Colo and Zook soils are poorly drained and have more clay than Kennebec soils. Judson soils have a cambic B horizon. Nodaway soils are stratified and have received more recent sediment than Kennebec soils.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, 400 feet west and 2,380 feet south of northeast corner sec. 26, T. 9 N., R. 6 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, friable; medium acid; clear smooth boundary.

A12—10 to 19 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine and medium granular structure; hard, friable; medium acid; clear smooth boundary.

A13—19 to 45 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; hard, friable; medium acid; gradual smooth boundary.

A14—45 to 56 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, firm; medium acid; gradual smooth boundary.

AC—56 to 60 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate coarse

and medium subangular blocky structure; slightly hard, firm; slightly acid; clear smooth boundary.

The A horizon ranges from 36 to 60 inches in thickness. It is black, very dark brown, or very dark gray. Reaction is slightly acid or medium acid. The AC horizon is very dark grayish brown or very dark gray. The lower part of the solum ranges from 24 to 30 percent content of clay. Typically, there are no free carbonates to a depth of 60 inches or more.

Lamo series

The Lamo series consists of deep, somewhat poorly drained soils. Permeability is moderately slow. The soils formed in calcareous alluvium on bottom lands. Slope ranges from 0 to 2 percent.

Lamo soils are similar to and adjacent to Colo, Kennebec, Salmo, and Zook soils. Colo, Kennebec, and Zook soils do not have carbonates. In addition, Kennebec soils are better drained, and Zook soils have more clay in the control section. Salmo soils are slightly or moderately affected with soluble salts.

Typical pedon of Lamo silty clay loam, 0 to 2 percent slopes, 750 feet north and 100 feet east of southwest corner sec. 32, T. 8 N., R. 6 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—7 to 29 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; strong effervescence; mildly alkaline; gradual wavy boundary.

AC—29 to 34 inches; 60 percent very dark gray (10YR 3/1), 40 percent dark grayish brown (2.5YR 4/2) silty clay loam, 60 percent dark gray (10YR 4/1), 40 percent grayish brown (2.5YR 5/2) dry; weak medium and fine subangular blocky structure; hard, friable; violent effervescence; mildly alkaline; clear wavy boundary.

C—34 to 60 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium distinct strong brown (7.5YR 5/6) mottles; massive; hard, friable; violent effervescence; mildly alkaline.

The solum and mollic epipedon range from 24 to 35 inches in thickness. The depth to free carbonates is less than 10 inches. The solum is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 through 5 dry), and chroma of 1. It is dominantly silty clay loam but includes small areas of heavy silt loam. The AC horizon has hue of 10YR or 2.5Y, value of 3, 4, or 5 dry, and chroma of 1 or 2.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 through 6 (5 through 7 dry); and chroma of 1 or 2. It is silty clay loam or light silty clay. The control section averages between 28 and 35 percent content of clay. The C horizon commonly has mottles with hue of 7.5YR or 5YR, value of 4 through 7, and chroma of 4 through 8.

Malcolm series

The Malcolm series consists of deep, well-drained, upland soils on ridgetops and side slopes. Permeability is moderate. The soils formed in lacustrine silt. Slope ranges from 6 to 25 percent.

Malcolm soils are commonly adjacent to Morrill, Pawnee, Sharpsburg, Shelby, and Steinauer soils. All of these soils have more clay in the control section than Malcolm soils. Morrill, Pawnee, and Shelby soils formed in glacial till. Sharpsburg soils formed in loess.

Typical pedon of Malcolm silt loam, 11 to 25 percent slopes, 100 feet south and 2,000 feet east of northwest corner sec. 28, T. 12 N., R. 6 E.

A11—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

A12—6 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable; medium acid; clear smooth boundary.

B1—10 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; medium acid; clear smooth boundary.

B2t—15 to 22 inches; brown (10YR 4/3) heavy silt loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard; friable; medium acid; clear smooth boundary.

B3—22 to 28 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; medium acid; clear smooth boundary.

C1—28 to 38 inches; pale brown (10YR 6/3) silt loam, very pale brown (10YR 7/3) dry; weak coarse prismatic structure; soft, very friable; slightly acid; gradual smooth boundary.

C2—38 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, very pale brown (10YR 7/3) dry; massive; soft, very friable; slightly acid.

The solum ranges from 17 to 40 inches in thickness. The mollic epipedon is 7 to 18 inches thick. Depth to carbonates is more than 60 inches.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It dominantly is silt loam, but the range includes silty clay loam. The B2 horizon has hue

of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 3. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 5 or 6 (5 through 8 dry), and chroma of 3. It is typically very fine sandy loam or silt loam. Many pedons have strata of fine sandy loam, loamy fine sand, or fine sand.

Mayberry series

The Mayberry series consists of deep, moderately well drained, upland soils that formed in material reworked from glacial deposits. Permeability is slow. Slope ranges from 2 to 11 percent.

Mayberry soils are commonly adjacent to Geary, Morrill, and Pawnee soils. Morrill and Geary soils have less clay in the B2t horizon than Mayberry soils. In addition, Geary soils formed in loess. Pawnee soils formed in material weathered from glacial till, and they are less red in hue than Mayberry soils.

Typical pedon of Mayberry silty clay loam, 2 to 7 percent slopes, eroded, 120 feet south and 1,750 feet west of northeast corner sec. 18, T. 12 N., R. 5 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

B1—7 to 12 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable; medium acid; gradual wavy boundary.

B21t—12 to 36 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/4) dry; strong medium prismatic structure parting to strong medium blocky; very hard, firm; neutral; gradual smooth boundary.

B22t—36 to 48 inches; reddish brown (5YR 4/4) clay, yellowish red (5YR 5/6) dry; moderate medium prismatic structure parting to moderate medium blocky; very hard, firm; common small black masses (iron-manganese); neutral; gradual smooth boundary.

B3—48 to 58 inches; brown (7.5YR 4/4) clay loam, strong brown (7.5YR 5/6) dry; common medium distinct yellowish red (5YR 4/8) mottles; weak medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

C—58 to 60 inches; strong brown (7.5YR 5/6) clay loam, reddish yellow (7.5YR 6/6) dry; massive; slightly hard, friable; neutral.

The solum ranges from 40 to more than 60 inches in thickness. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is predominantly silty clay loam, but the range includes clay loam and clay. Reaction is medium acid or slightly acid. The B2t horizon has hue of 7.5YR or 5YR, value of 3 through 6 (4 through 6 dry), and chroma of 3 or 4. It is predominantly clay, but the range includes silty clay, silty clay loam, and clay loam. The content of clay averages 40 to 48 percent. The C horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 or 5 (5 through 7 dry); and chroma of 4 through 6. It is clay loam or clay and has bands of coarser material in places. The C horizon, B3 horizon, and lower part of the B2t horizon have a few small lime concretions in a few pedons.

Reddish brown loess has influenced the upper part of most pedons.

In Mayberry clay, 2 to 7 percent slopes, severely eroded, the surface layer is thinner than is defined for the Mayberry series.

Morrill series

The Morrill series consists of deep, well drained, upland soils that formed in till or outwash deposits of retreating glaciers. Permeability is moderately slow. Slope ranges from 6 to 15 percent.

Morrill soils are similar to Geary and Mayberry soils and are commonly adjacent to Pawnee and Sharpsburg soils. Geary soils are fine silty. Mayberry, Pawnee, and Sharpsburg soils are fine textured. In addition, Sharpsburg soils formed in loess.

Typical pedon of Morrill clay loam, 6 to 11 percent slopes, 1,900 feet east and 650 feet north of southwest corner sec. 4, T. 12 N., R. 7 E.

Ap—0 to 8 inches; dark brown (7.5YR 3/2) clay loam, dark brown (10YR 3/3) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

Blt—8 to 12 inches; dark reddish brown (5YR 3/3) clay loam, dark brown (7.5YR 4/4) dry; moderate medium and fine subangular blocky structure; slightly hard, friable; medium acid; clear wavy boundary.

B2t—12 to 32 inches; reddish brown (5YR 4/3) clay loam, brown (7.5YR 5/4) dry; moderate medium prismatic structure parting to moderate medium subangular; hard, firm; medium acid; gradual wavy boundary.

B3—32 to 51 inches; brown (7.5YR 4/4) clay loam, yellowish brown (10YR 5/4) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; medium acid; gradual wavy boundary.

C—51 to 60 inches; brown (7.5YR 5/4) clay loam, reddish yellow (7.5YR 6/6) dry; weak medium prismatic structure; slightly hard, friable; slightly acid.

The solum ranges from 30 to 65 inches in thickness. It is slightly acid to strongly acid. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 through 3. It is typically clay loam but includes small areas of loam and heavy sandy loam. The Bt horizons have hue of 7.5YR or 5YR, value of 3 or 4 (3 through 5 dry), and chroma of

3 through 5. They are typically clay loam, but in places they are sandy clay loam. The B3 horizon and C horizon have hue of 10YR through 5YR, value of 4 or 5 (4 through 6 dry), and chroma of 3 through 6.

In Morrill clay loam, 6 to 11 percent slopes, eroded, the surface layer is lighter colored than is defined for the series.

Nodaway series

The Nodaway series consists of deep, moderately well drained soils on bottom lands. Permeability is moderate. The soils formed in alluvium and occur in narrow drainageways. Slope ranges from 0 to 3 percent.

Nodaway soils are similar to and are commonly adjacent to Colo, Judson, and Kennebec soils. All of these soils have a mollic epipedon and do not have the stratification in the upper 10 inches of the profile of the Nodaway soils. Colo soils are more poorly drained than Nodaway soils. Judson soils have a B horizon and are on foot slopes that are higher lying than Nodaway soils.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, 100 feet north and 1,000 feet east of southwest corner sec. 29, T. 7 N., R. 8 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

C1—7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; massive, some weak platiness; few fine dark grayish brown (10YR 4/2) strata; slightly hard, friable; slightly acid; clear smooth boundary.

C2—14 to 45 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; massive, some platiness due to stratification; many fine and medium dark grayish brown (10YR 4/2) strata; slightly hard, friable; slightly acid; clear smooth boundary.

C3—45 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; massive; slightly hard; neutral.

The solum ranges from 6 to 10 inches in thickness. In some pedons the Ap horizon has strata with value of 4 or 5. The C horizon has hue of 10YR, value of 3 through 5 (4 through 6 dry), and chroma of 1 through 3. It is silt loam or silty clay loam. Depth to the silty clay loam layer ranges from 20 to more than 60 inches.

Pawnee series

The Pawnee series consists of deep, moderately well drained soils on uplands. Permeability is slow. The soils formed in glacial till. Slope ranges from 2 to 11 percent.

Pawnee soils are commonly adjacent to Burchard, Judson, Mayberry, Sharpsburg, and Wymore soils. Burchard and Judson soils have less clay in the B horizon than Pawnee soils. In addition, the Burchard soils are shallower to lime. Mayberry soils formed in reddish brown material from Kansan till. Wymore and Sharpsburg soils formed in loess.

Typical pedon of Pawnee clay loam, 2 to 7 percent slopes, eroded, 600 feet north and 2,570 feet east of southwest corner sec. 29, T. 9 N., R. 5 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure, slightly hard, friable; slightly acid; abrupt smooth boundary.

B21t—7 to 13 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; very hard, firm; many very dark brown (10YR 2/2) channel fillings; slightly acid; clear wavy boundary.

B22t—13 to 27 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) dry; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; many very dark brown (10YR 2/2) channel fillings; neutral; clear smooth boundary.

B23t—27 to 30 inches; olive brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; many very dark brown (10YR 2/2) channel fillings; few small lime concretions; mildly alkaline; clear wavy boundary.

B3t—30 to 38 inches; olive gray (5Y 5/4) clay, pale olive (5Y 6/4) dry; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, firm; few small iron-manganese concretions; many medium soft accumulations of carbonates; mildly alkaline; gradual wavy boundary.

C—38 to 60 inches; olive (5Y 5/4) clay loam, pale olive (5Y 6/4) dry; many medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; slightly hard, firm; common small soft very dark brown masses (iron-manganese); many small soft accumulations of carbonates; violent effervescence; moderately alkaline.

The solum ranges from 36 to 45 inches in thickness. The depth to free carbonates ranges from 26 to 50 inches. The mollic epipedon is 10 to 18 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. Some pedons have an Ap horizon of clay. Reaction is medium acid or slightly acid. The B2t horizon has hue of 10YR or 2.5Y, value of 3 through 5 (4 through 6 dry), and chroma of 2 through 4 with common or medium yellowish brown, strong brown, or reddish brown mottles. Reaction ranges from medium acid to

mildly alkaline. The content of clay ranges from 40 to 50 percent. The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6 (6 or 7 dry); and chroma of 2 through 4. A few stones and pebbles are commonly on the surface and throughout the profile.

In Pawnee clay, 2 to 7 percent slopes, severely eroded, the dark surface layer is thinner than is defined for the series.

Salmo series

The Salmo series consists of deep, poorly drained soils on bottom lands. Permeability is moderately slow. The soils formed in silty alluvium that is slightly to moderately affected with soluble salts. Slope ranges from 0 to 2 percent.

Salmo soils are commonly adjacent to soils which are not affected with soluble salts or exchangeable sodium, for example, Nodaway, Kennebec, Lamo, and Zook soils. In addition, Zook soils have more clay in the control section than Salmo soils.

Typical pedon of Salmo silty clay loam, channelled, 0 to 2 percent slopes, 500 feet south and 500 feet east of northwest corner sec. 4, T. 12 N., R. 7 E.

A11—0 to 3 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; hard, friable; slight effervescence; 0.31 percent soluble salts; mildly alkaline; abrupt smooth boundary.

A12—3 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; hard, friable; slight effervescence; 0.16 percent soluble salts; mildly alkaline; clear smooth boundary.

A13—9 to 15 inches; black (10YR 2/1) silty clay loam; very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; hard, friable; slight effervescence; 0.16 percent soluble salts; mildly alkaline; clear smooth boundary.

AC—15 to 24 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; hard, friable; strong effervescence; 0.18 percent soluble salts; moderately alkaline; gradual smooth boundary.

C1—24 to 45 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, gray (5Y 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; hard, friable; strong effervescence; 0.18 percent soluble salts; mildly alkaline; gradual smooth boundary.

C2—45 to 60 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 5/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable; slight effervescence; 0.11 percent soluble salts; mildly alkaline.

The mollic epipedon ranges from 24 to 45 inches in thickness. The depth to free carbonates is less than 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is generally silty clay loam, but the range includes silt loam. The electrical conductivity of the A11 horizon ranges from 4.0 to 12.0. The sodium adsorption ratio is more than 15. The control section averages between 28 and 35 percent content of clay. The C horizon has hue of 2.5Y or 5Y, value of 2 through 4 (4 through 6 dry), and chroma of 1 or 2. Yellowish brown or dark yellowish brown mottles range from few to many.

Sharpsburg series

The Sharpsburg series consists of deep, moderately well drained soils on uplands and terraces. Permeability is moderately slow. The soils formed in loess on uplands and stream terraces. Slope ranges from 0 to 15 percent.

Sharpsburg soils are commonly adjacent to Wymore, Pawnee, Mayberry, Morrill, and Geary soils. In places the nearly level Sharpsburg soils are adjacent to Butler and Crete soils. Pawnee, Mayberry, and Morrill soils formed in glacial till. Wymore, Pawnee, Mayberry, Butler, and Crete soils have more clay in the B2 horizon than Sharpsburg soils, and Geary soils have less clay and are of redder hue.

Typical pedon of Sharpsburg silty clay loam, 2 to 5 percent slopes, 100 feet west and 2,000 feet north of southeast corner sec. 20, T. 12 N., R. 8 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

B1t—7 to 12 inches; dark brown (10YR 3/3) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, firm; medium acid; clear wavy boundary.

B21t—12 to 23 inches; brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate subangular blocky; hard, firm; medium acid; gradual smooth boundary.

B22t—23 to 34 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; slightly acid; gradual smooth boundary.

B3—34 to 44 inches; yellowish brown (10YR 5/4) silty clay loam, very pale brown (10YR 7/4) dry; few fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slightly acid; gradual smooth boundary.

C—44 to 60 inches; light yellowish brown (10YR 6/4) silty clay loam, very pale brown (10YR 7/4) dry;

common fine faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; slightly hard, friable; few small very dark brown iron-manganese concretions; slightly acid.

The solum ranges from 36 to 50 inches in thickness. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. Reaction ranges from strongly acid to slightly acid. The B2t horizon has hue of 10YR, value of 3 through 5 (4 through 6 dry), and chroma of 2 through 4. It is silty clay loam or silty clay that ranges from 36 to 42 percent content of clay. The B3 horizon and the C horizon have hue of 10YR or 2.5Y, value of 4 through 6 (5 through 7 dry), and chroma of 2 through 4. Mottles have hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 4 through 6. Also included are grayish brown and olive gray mottles. In some places the B3 horizon and the C horizon are mixed brown and gray.

In Sharpsburg silty clay loam, 5 to 9 percent slopes, eroded, and Sharpsburg silty clay loam, 9 to 15 percent slopes, eroded, the dark surface layer is thinner than is defined for the series.

Shelby series

The Shelby series consists of deep, moderately well drained soils on uplands. Permeability is moderately slow. The soils formed in loamy glacial material. Slope ranges from 6 to 11 percent.

Shelby soils are commonly adjacent to Burchard, Judson, Pawnee, Sharpsburg, and Steinauer soils. Sharpsburg soils formed in loess. Sharpsburg and Judson soils have less fine and coarse sand throughout the profile than Shelby soils. In addition, Judson soils have a thicker A horizon. Burchard and Steinauer soils have carbonates at a shallower depth than Shelby soils, and Steinauer soils do not have an argillic horizon. Pawnee soils have more clay in the argillic horizon than Shelby soils.

Typical pedon of Shelby clay loam, 6 to 11 percent slopes, 220 feet east and 1,200 feet south of northwest corner sec. 4, T. 11 N., R. 5 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A12—7 to 13 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; medium acid; clear wavy boundary.

B1—13 to 19 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate coarse and medium subangular blocky structure; slightly hard, friable; medium acid; gradual smooth boundary.

B21t—19 to 32 inches; brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; contains 1 to 2 percent gravel; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; medium acid; gradual smooth boundary.

B22t—32 to 55 inches; brown (10YR 5/3) clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish red (5YR 4/6) mottles; strong medium prismatic structure parting to moderate medium blocky; hard, friable; medium acid; gradual smooth boundary.

B3—55 to 60 inches; brown (10YR 5/3) clay loam, mixed brown (10YR 5/3) and pale brown (10YR 5/6) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; slightly hard, friable; slightly acid.

The solum ranges from 35 to more than 60 inches in thickness. Free carbonates are commonly below a depth of 60 inches, but the range includes carbonates as shallow as 40 inches in depth.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is dominantly clay loam, but the range includes loam. Reaction is strongly acid or medium acid. The B2t horizon has value of 4 or 5 (4 through 6 dry) and chroma of 3 or 4. It is dominantly clay loam and averages 30 to 35 percent content of clay. Where C horizons are present, they have hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. They are dominantly clay loam, but the range includes loam.

Sogn series

The Sogn series consists of shallow and very shallow, somewhat excessively drained soils on uplands. Permeability is moderate. The soils formed in material weathered from limestone. Slope ranges from 6 to 30 percent.

Sogn soils are similar to Hedville soils, and are commonly adjacent to Burchard and Steinauer soils. Hedville soils formed in material weathered from sandstone. The deep Burchard and Steinauer soils formed in Kansan till.

Typical pedon of Sogn silty clay loam from an area of Sogn-Rock outcrop complex, 11 to 30 percent slopes, 2,100 feet north and 2,500 feet west of southeast sec. 8, T. 8 N., R. 7 E.

A11—0 to 6 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium granular structure; hard, friable; strong effervescence; neutral; clear smooth boundary.

A12—6 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to weak medium granular; slightly hard, friable; strong effervescence; mildly alkaline; clear smooth boundary.

R—9 to 60 inches; bedded indurated limestone that has joints averaging about 18 inches apart and less than 1/4 inch wide.

The solum and depth to limestone bedrock range from 4 to 20 inches.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 through 3. It is dominantly silty clay loam, but the range includes loam. The A horizon contains few to many limestone fragments. The boundary between the A horizon and bedrock ranges from abrupt to gradual and from smooth to irregular depending on the density and consolidation of the limestone. Most bedrock is dense and hard.

Steinauer series

The Steinauer series consists of deep, well drained to excessively drained soils on uplands. Permeability is moderately slow. The soils formed in calcareous glacial till on narrow ridgetops and on side slopes. Slope ranges from 6 to 40 percent.

Steinauer soils are commonly adjacent to Burchard, Dickinson, Malcolm, Shelby, and Pawnee soils. Those soils have a mollic epipedon, a B horizon, and carbonates below a depth of 14 inches. Dickinson soils have a higher content of sand and less clay in the control section than Steinauer soils. Malcolm soils have a lower content of clay and fine and coarse sand in the control section. Pawnee soils have a clay B2t horizon.

Typical pedon of Steinauer loam, 11 to 30 percent slopes, 100 feet south and 1,890 feet west of northeast corner sec. 29, T. 9 N., R. 5 E.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; slightly hard, friable; slight effervescence; mildly alkaline; clear wavy boundary.

AC—5 to 12 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable; strong effervescence; mildly alkaline; clear smooth boundary.

C1—12 to 25 inches; yellowish brown (10YR 5/4) loam, very pale brown (10YR 7/4) dry; common medium faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; slightly hard, friable; few small soft black masses (iron-manganese); few small soft accumulations of carbonates; violent effervescence; mildly alkaline; clear smooth boundary.

C2—25 to 60 inches; light olive brown (2.5Y 5/4) clay loam, pale yellow (2.5Y 7/4) dry; many medium distinct yellowish red (5YR 5/8) mottles; weak coarse prismatic structure; hard, firm; common small soft black masses (iron-manganese); few thin discontinuous film coatings on ped faces; violent effervescence; mildly alkaline.

The solum ranges from 6 to 15 inches in thickness. The depth to free carbonates ranges from 0 to 10 inches in thickness.

The A horizon has value of 3 through 5 (4 through 6 dry) and chroma of 2. It dominantly is loam, but the range includes clay loam. The AC horizon has value of 4 or 5 (5 or 6 dry) and chroma of 2 or 3. The C horizon has hue of 10YR, 7.5YR, or 2.5Y; value of 5 or 6 (6 or 7 dry); and chroma of 2 through 4. In some pedons, the C horizon contains yellowish brown, strong brown, or reddish brown iron stains. It is loam or clay loam. Stones vary in size and amount from place to place throughout the profile, and pockets or lenses of sand occur in places.

Wabash series

The Wabash series consists of deep, poorly drained soils on bottom lands. Permeability is very slow. The soils formed in fine textured alluvium. Slope ranges from 0 to 1 percent.

Wabash soils are commonly adjacent to Kennebec and Zook soils. The adjacent soils have less clay in the 10- to 40-inch control section than the Wabash soils. In addition, Kennebec soils are better drained.

Typical pedon of Wabash silty clay, 0 to 1 percent slopes, 300 feet south and 2,300 feet east of northwest corner sec. 16, T. 11 N., R. 8 E.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine granular structure; hard, firm; medium acid; abrupt smooth boundary.

A3—9 to 21 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine faint (10YR 3/3) mottles; moderate medium blocky structure; very hard, very firm; medium acid; clear wavy boundary.

B2g—21 to 53 inches; black (10YR 2/1) silty clay, dark gray (10YR 3/1) dry; many medium distinct olive brown (2.5Y 4/4) mottles; strong medium and coarse prismatic structure parting to strong medium and coarse blocky; very hard, extremely firm; shiny surface on vertical faces of peds; neutral; gradual wavy boundary.

B3g—53 to 60 inches; very dark gray (5Y 3/1) silty clay, dark gray (5Y 4/1) dry; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; mildly alkaline.

The solum ranges from 40 to more than 60 inches in thickness.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. Reaction is medium acid or slightly acid. Below the Ap horizon, the A horizon has brown, dark brown, or reddish brown mottles. The B2g horizon has hue of 10YR, 2.5Y, or 5Y; value of 2 or 3; and chroma of 1. It is silty clay and averages between 46 and 60 percent content of clay. If present, the B3 horizon and the C horizon have hue of 5Y, value of 4 or 5, and chroma of 1. In a few places, these horizons have a few lime concretions.

Wymore series

The Wymore series consists of deep, moderately well drained soils on uplands. Permeability is slow. The soils formed in loess and are on nearly level divides, rounded ridgetops, and side slopes. Slope ranges from 0 to 11 percent.

Wymore soils are commonly adjacent to Crete, Judson, Mayberry, Pawnee, and Sharpsburg soils. Crete soils have a thicker mollic epipedon than Wymore soils, and they usually have less clay in the Ap horizon. Mayberry and Pawnee soils formed in glacial till. Sharpsburg soils have higher chroma in the argillic horizon than Wymore soils.

Typical pedon of Wymore silty clay loam, 3 to 7 percent slopes, eroded, 100 feet east and 2,100 feet north of southwest corner sec. 29, T. 8 N., R. 7 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, firm; slightly acid; abrupt smooth boundary.

B21t—8 to 11 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

B22t—11 to 24 inches; dark grayish brown (10YR 4/2) silty clay; grayish brown (10YR 5/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; few thin discontinuous film coatings on faces of peds; very dark brown (10YR 2/2) channel fillings in places; neutral; clear smooth boundary.

B23t—24 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many fine faint (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; few thin discontinuous film coatings on faces of peds; very dark brown (10YR 2/2) channel fillings in places; neutral; clear wavy boundary.

B3—30 to 38 inches; olive brown (2.5Y 4/4) silty clay loam, light olive brown (2.5Y 5/4) dry; many medium distinct strong brown (10YR 5/6), olive gray (5Y 5/2), and brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; few medium soft black masses (iron-manganese); few medium soft accumulations of carbonates; neutral; gradual smooth boundary.

C—38 to 60 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; many medium distinct brown (7.5YR 4/4) and yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few medium soft black masses (iron manganese); few small soft accumulations of carbonates; mildly alkaline.

The solum ranges from 34 to 60 inches in thickness. The mollic epipedon is 10 to 18 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is silty clay loam or silty clay that ranges between 32 and 45 percent content of clay. Reaction is medium acid or slightly acid. The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 through 4. It is silty clay that ranges between 42 and 50 percent content of clay. Mottles are dark yellowish brown, yellowish brown, or yellowish red. Reaction is slightly acid or neutral. The B3 horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4 and is mottled. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 dry, and chroma of 1 or 2.

In Wymore silty clay, 5 to 9 percent slopes, severely eroded, the surface layer is thinner and lighter colored than is defined for the series.

Zoe series

The Zoe series consists of deep, poorly drained soils on bottom lands. Permeability is slow. The soils formed in alluvium that is slightly to moderately affected with soluble salts. Slope ranges from 0 to 2 percent.

Zoe soils are commonly adjacent to Kennebec, Lamo, Salmo, and Wabash soils. Kennebec, Lamo, and Salmo soils have less clay in the control section than Zoe soils. Wabash soils have more clay in the control section. Except for Salmo soils, the adjacent soils are not affected with soluble salts or exchangeable sodium.

Typical pedon of Zoe silty clay loam, 0 to 2 percent slopes, 1,600 feet west and 2,500 feet south of northeast corner sec. 26, T. 11 N., R. 7 E.

A11—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard; friable; 0.02 percent soluble salts; slightly acid; abrupt smooth boundary.

A12—8 to 18 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; 0.18 percent soluble salts; neutral; clear wavy boundary.

A13—18 to 39 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate fine granular; hard, firm; 0.56 percent soluble salts; mildly alkaline; gradual smooth boundary.

B1—39 to 55 inches; very dark (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate medium blocky; hard, firm; small soft accumulations of carbonates, 0.34 percent soluble salts; mildly alkaline; gradual smooth boundary.

B2—55 to 60 inches; dark gray (5Y 4/1) silty clay; gray (5Y 5/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky;

hard, firm; slight effervescence; 0.07 percent soluble salts; strongly alkaline.

The solum ranges from 40 to more than 60 inches in thickness. The mollic epipedon is 36 to 50 inches thick.

The A horizon has hue of 10YR or is neutral, value of 2 or 3 (3 through 4 dry), and chroma of 1 or less. Electrical conductivity of the saturation extract ranges from 4 to 15 between a depth of 10 to 24 inches. The sodium adsorption ratio is more than 13. Content of clay in the control section is between 36 and 46 percent. The B2 horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 through 5 (4 through 6 dry); and chroma of 0 through 2. Mottles of high chroma and value are in some pedons.

Zook series

The Zook series consists of deep, somewhat poorly drained or poorly drained soils on bottom lands. Permeability is slow. The soils formed in alluvium along streams. Slope ranges from 0 to 2 percent.

Zook soils are commonly adjacent to Judson, Kennebec, Wabash, and Colo soils. Judson and Kennebec soils are better drained and have less clay in the control section than Zook soils. Colo soils have less clay in the control section, and Wabash soils have more clay in the control section than Zook soils.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, 200 feet south and 2,500 feet east of northwest corner sec. 17, T. 11 N., R. 6 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A12—9 to 18 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; medium acid; gradual wavy boundary.

A13—18 to 26 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; medium acid; gradual wavy boundary.

B21—26 to 36 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; slightly acid; clear wavy boundary.

B22—36 to 51 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; neutral; gradual wavy boundary.

B3—51 to 60 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few medium distinct olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure; hard, firm; neutral; gradual wavy boundary.

The solum ranges from 36 to more than 60 inches in thickness. The A horizon is 20 to 36 inches thick.

The A horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1 or 2. It is silt loam or silty clay loam. Reaction is medium acid or slightly acid. The B2 horizon has value of 2 or 3 (3 through 5 dry) and chroma of 1. It is silty clay loam or silty clay and averages between 38 and 46 percent content of clay. If present, the C horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 through 5 (5 or 6 dry); and chroma of 1. Reddish brown, yellowish brown, or brownish yellowish mottles are common in the C horizon.

Formation of the soils

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. Some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the earth material from which a soil is formed, and it is largely responsible for the mineralogical composition of the soil. In Lancaster County, the soils formed in nine kinds of parent material. In age of deposit from the oldest to the youngest, these parent materials are: limestone, sandstone, glacial till, lacustrine silt, glacial outwash, Loveland Loess, Peorian Loess, colluvium, and alluvium.

Only a small acreage of soil has formed from limestone and sandstone materials because these materials generally are deeply covered. Hedville soils formed in strong brown, sandy material weathered from sandstone,

and Sogn soils formed in silty material weathered from limestone. These soils are shallow because the solid rock is resistant to weathering. The dominant vegetation is grasses or stands of mixed grasses, shrubby brush, and trees.

Glacial till is part of the upland landscape. Unoxidized till is generally grayish, but if it is exposed and weathered, it becomes brownish. Till is a fine earth mixture of silt, sand, and clay studded with pebbles and occasionally with stones. Lime concretions of soft carbonate accumulation are common. In some places, this material contains small pockets of sand and gravel. Burchard, Pawnee, and Steinauer soils developed in material weathered from glacial till.

Malcolm soils formed in lake deposited material. This material consists mainly of very fine sand or silt size particles. A few stones or boulders from adjacent, higher lying glacial till are on the surface. Only small areas of this lacustrine material are exposed.

Areas of reddish to brownish glacial outwash or reworked till are exposed throughout the upland areas and are associated with till. The soil formed in this material ranges widely from clay to sand. Dickinson soils formed in sandy outwash. Morrill soils formed in loamy sediment that contains many sand grains and a few pebbles. Mayberry soils formed in clayey sediment that contains sand and pebbles. In a few areas, Mayberry soils developed in till or old alluvium.

Loveland Loess is dark brown to yellowish red in this county. It is older than Peorian Loess and is more oxidized. This material generally occupies ridges and is less than 10 feet thick. Geary soils developed in Loveland Loess. The acreage of this parent material is small in this county.

Peorian Loess is the most extensive of the soil forming materials in the county. This grayish to brownish silty clay loam material ranges from a few feet to about 20 feet in thickness. Butler, Crete, Fillmore, Sharpsburg, and Wymore soils formed in material weathered from Peorian Loess. These soils are generally in the uplands; however, they also formed in loess or loesslike material of alluvial origin on stream terraces.

Colluvium is on foot slopes or lower side slopes adjacent to steeper uplands and consists of recent, deep sediment of friable material deposited by the combined effects of gravity and moving water. It is generally brown and includes silt loam, silty clay loam, loam, and clay loam. Judson soils developed in colluvial material.

The recent, dark alluvium of the valleys consists of silty and clayey sediments washed from upland slopes and deposited on flood plains. Colo, Kennebec, Lamo, Nodaway, Salmo, Wabash, and Zook soils formed in this alluvial material. In most places, these soils are frequently or occasionally flooded and fresh deposits continue to accumulate.

Climate

Climate is an active factor in the formation of soils. Its influence is both direct and indirect. In the past, cold temperatures activated glaciers that left till material, and dry and windy periods produced eolian or dust particles that accumulated as loess deposits. At present, the movement of water received as rain influences the shape of the landscape, and alternate freezing and thawing of the soil hastens disintegration of parent material. Indirectly, climate affects the soils because it influences the amount and kind of vegetation and animal life living on them.

The continental climate of Lancaster County has seasonal variations. The winter is moderately long and cold, and temperatures are commonly below 0 degrees F. Spring is cool, and there is considerable precipitation. Summer is warm, and temperatures are commonly higher than 95 degrees F. Thunderstorms are common during summer and late in spring. The fall season is mild, and there are occasional periods of rain. The average mean temperature is about 52 degrees F., and the annual precipitation is about 27 inches.

Enough precipitation enters the soil and moves through it to move the carbonates and other soluble elements to a depth of at least 2 feet in most soils. Except for some of the steeper soils, most of the soils in Lancaster County are strongly acid to slightly acid in the surface layer. The soils are somewhat leached, but they retain a high percentage of basic mineral elements.

Plant and animal life

Grass, trees, animals, micro-organisms, earthworms, man, and other kinds of plants and animals live on or in the soil and are active in the soil forming processes. The kinds of plants and animals present are determined by environmental factors, for example, climate, parent material, age of the soil, relief, and drainage.

Before the soils were cultivated, the dominant vegetation in Lancaster County was mid and tall grasses. This kind of vegetation provides an abundance of organic matter that affects the physical and chemical properties of the soil and supplies the dark color to the surface layer. The fibrous roots of these grasses penetrate the soil, make it porous, and encourage development of granular structures. The plant roots take up minerals in solution from the lower parts of the soil and eventually return them to the surface.

Micro-organisms, insects, earthworms, and burrowing rodents are beneficial to the soil structure, and make the soil more fertile and more productive. Micro-organisms convert organic remains into a stable humus from which living plants obtain nutrients. Earthworms, insects, and small burrowing rodents make openings and channels in the soil and aerate, loosen, and mix it. Their remains add to the content of organic matter.

Relief

Relief, or lay of the land, influences the formation of soil by affecting runoff, erosion, and drainage. Runoff is more rapid on steep and very steep slopes than on more gentle slopes. Less water penetrates the soil on areas that have rapid runoff, and absence of water reduces the amount of vegetation. Water can remove the soil almost as fast as it is formed. In Lancaster County, the steep Steinauer soils have little soil profile development other than a slightly darkened, thin surface layer.

Soils in slight depressional areas, such as the Fillmore soils, collect run-in water and have characteristics that result from deep percolation of additional amounts of moisture. Clay colloids are leached to form a grayish leached subsurface layer and are then deposited as a dark, clayey subsoil. These claypan soils have very slow permeability.

Some of the nearly level soils on bottom lands are somewhat poorly drained or poorly drained because they have slow runoff or a moderately high water table. Zook soils and Wabash soils are clayey soils that have slow or very slow runoff. A high water table can change the chemical composition of the nutrients of the parent material. The somewhat poorly drained Lamo soils are calcareous at the surface. The lime content is maintained by capillary action of moisture above the water table.

Time

The passage of time enables the factors of relief, climate, and plant and animal life to bring about the changes in parent material that result in the formation of soil. Generally, soils have to be in place for some time to develop genetic profiles and thick horizons. If the parent material has been in place for only a short time, the soils are weakly developed because climate and vegetation have not been acting upon the soils for very long. The Kennebec soils and Nodaway soils are weakly developed soils. These soils formed in recent alluvium deposits during the last few centuries. Some of these soils have formed during the last few years.

The Butler, Crete, Fillmore, Sharpsburg, and Wymore soils developed in Peorian Loess and have been in place long enough to have formed well-defined, genetically related horizons. Pawnee soils, which formed in glacial till, also have well-defined, genetically related horizons. However, because these soils have been developing for a shorter period of time than the soils formed in Peorian Loess, they are less deeply leached of carbonates. The longer the parent material is exposed to soil development, the more nearly the soil reaches a balance with its environment.

Mechanical and chemical analysis

Samples from soil profiles were collected for mechanical and chemical analysis by the National Soil Survey Laboratory, Soil Conservation Service, in Lincoln, Nebraska. Two pedons of Wymore soil were collected in Lancaster County. Pedons of Burchard, Morrill, Pawnee, Sharpsburg, Wabash, and Wymore soils were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 (*5*).

This information is useful to soil scientists in classifying soils and in developing concepts of soil genesis. It is also helpful in estimating available water capacity, susceptibility to wind erosion, fertility, degree of tilth, and other aspects of the soil that influence soil management.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses.

Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth, soil. The total thickness of weathered soil material over bedrock. In this survey the classes of soil depth are very shallow, 0 to 10 inches; shallow, 10 to 20 inches; moderately deep, 20 to 40 inches; and deep, more than 40 inches.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden

deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic matter content. The amount of organic matter in soil material. The classes used in this survey are very low, less than 0.5 percent organic matter present; low, 0.5 to 1.0 percent; moderately low, 1.0 to 2.0 percent; moderate, 2.0 to 4.0 percent; and high, 4.0 to 8.0 percent.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet

in 100 feet of horizontal distance. In this survey, the classes of slope are:

	Percent
Nearly level	0 to 2
Very gently sloping	1 to 3
Gently sloping	2 to 7
Strongly sloping	5 to 11
Moderately steep	9 to 15
Steep	15 to 30
Very steep	30 to 60

Slow intake (in tables). The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moist content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-73 at Lincoln, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	31.6	13.6	22.6	60	-12	0	.67	.26	1.00	2	6.2
February---	37.6	18.7	28.2	69	-7	0	1.09	.27	1.73	3	6.6
March------	47.6	28.2	37.9	82	1	56	1.84	.49	2.91	4	6.1
April------	62.9	40.9	51.9	89	23	104	2.32	1.13	3.28	5	.7
May--------	74.0	52.9	63.4	95	33	422	3.93	2.41	5.29	7	.2
June-------	83.8	62.6	73.2	100	46	696	4.64	1.82	6.91	6	.0
July-------	87.9	67.3	77.6	103	53	856	4.18	2.54	5.64	6	.0
August-----	86.7	65.4	76.2	102	51	812	3.22	1.77	4.40	6	.0
September--	76.5	55.6	66.1	97	37	483	3.94	1.86	5.64	6	.0
October----	67.1	45.2	56.2	89	25	239	2.17	.53	3.47	4	.3
November---	49.7	30.7	40.3	74	10	10	1.13	.28	1.79	3	2.6
December---	37.4	19.9	28.7	65	-8	6	.78	.26	1.18	2	5.6
Yearly:											
Average--	61.9	41.8	51.9	---	---	---	---	---	---	---	---
Extreme--	---	---	---	104	-13	---	---	---	---	---	---
Total----	---	---	---	---	---	3,684	29.91	25.15	34.66	54	28.3

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-73 at Lincoln, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 10	April 20	May 2
2 years in 10 later than--	April 4	April 15	April 27
5 years in 10 later than--	March 25	April 7	April 18
First freezing temperature in fall:			
1 year in 10 earlier than--	October 24	October 23	October 5
2 years in 10 earlier than--	October 29	October 27	October 10
5 years in 10 earlier than--	November 7	November 3	October 20

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-73 at Lincoln, Nebraska]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	200	191	164
8 years in 10	209	197	171
5 years in 10	226	209	184
2 years in 10	244	221	197
1 year in 10	253	228	203

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
BpF	Burchard-Nodaway complex, 2 to 30 percent slopes	6,400	1.2
BrD	Burchard clay loam, 6 to 11 percent slopes	10,200	1.9
BrE	Burchard clay loam, 11 to 15 percent slopes	3,300	0.6
Bu	Butler silt loam, 0 to 1 percent slopes	2,000	0.4
Bw	Butler silt loam, terrace, 0 to 1 percent slopes	2,050	0.4
Co	Colo silty clay loam, 0 to 2 percent slopes	2,900	0.5
Cp	Colo-Nodaway silty clay loams, 0 to 2 percent slopes	7,600	1.4
Cr	Crete silt loam, terrace, 0 to 1 percent slopes	4,000	0.7
CrB	Crete silty clay loam, terrace, 1 to 3 percent slopes	4,000	0.7
CrC	Crete silty clay loam, terrace, 3 to 6 percent slopes	1,450	0.3
CsB	Crete Variant silty clay loam, 1 to 4 percent slopes	1,400	0.3
Ct	Crete silt loam, 0 to 2 percent slopes	9,200	1.7
DcD	Dickinson fine sandy loam, 6 to 11 percent slopes	1,600	0.3
DcD2	Dickinson fine sandy loam, 6 to 11 percent slopes, eroded	446	0.1
Fm	Fillmore silt loam, 0 to 1 percent slopes	410	0.1
GeD	Geary silty clay loam, 6 to 11 percent slopes	920	0.2
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded	460	0.1
HeF	Hedville sandy loam, 6 to 30 percent slopes	190	*
JfC	Judson fine sandy loam, 2 to 6 percent slopes	330	0.1
JuC	Judson silt loam, 2 to 6 percent slopes	29,500	5.4
Ke	Kennebec silt loam, 0 to 2 percent slopes	22,900	4.2
Lm	Lamo silty clay loam, 0 to 2 percent slopes	1,800	0.3
McD	Malcolm silt loam, 6 to 11 percent slopes	770	0.1
McF	Malcolm silt loam, 11 to 25 percent slopes	460	0.1
MeC2	Mayberry silty clay loam, 2 to 7 percent slopes, eroded	10,700	2.0
MeD2	Mayberry silty clay loam, 7 to 11 percent slopes, eroded	1,850	0.3
MhC3	Mayberry clay, 2 to 7 percent slopes, severely eroded	1,400	0.3
MrD	Morrill clay loam, 6 to 11 percent slopes	6,900	1.3
MrD2	Morrill clay loam, 6 to 11 percent slopes, eroded	3,500	0.6
MrE	Morrill clay loam, 11 to 15 percent slopes	810	0.1
No	Nodaway silt loam, 0 to 2 percent slopes	16,800	3.1
Ns	Nodaway silt loam, channeled	15,900	2.9
PaC2	Pawnee clay loam, 2 to 7 percent slopes, eroded	35,000	6.3
PaD2	Pawnee clay loam, 7 to 11 percent slopes, eroded	17,300	3.2
PbC3	Pawnee clay, 2 to 7 percent slopes, severely eroded	4,600	0.8
Pt	Pits, quarries	270	*
Sa	Salmo silt loam, 0 to 2 percent slopes	900	0.2
Sb	Salmo silty clay loam, channeled, 0 to 2 percent slopes	2,300	0.4
Sc	Salmo silty clay loam, 0 to 2 percent slopes	2,480	0.5
ShC	Sharpsburg silty clay loam, 2 to 5 percent slopes	40,750	7.4
ShD	Sharpsburg silty clay loam, 5 to 9 percent slopes	59,000	10.7
ShD2	Sharpsburg silty clay loam, 5 to 9 percent slope, eroded	28,000	5.1
ShE2	Sharpsburg silty clay loam, 9 to 15 percent slopes, eroded	950	0.2
Sk	Sharpsburg silty clay loam, terrace, 0 to 2 percent slopes	3,570	0.7
SmD	Shelby clay loam, 6 to 11 percent slopes	8,600	1.6
SoF	Sogn-Rock outcrop complex, 11 to 30 percent slopes	200	*
StD	Steinauer loam, 6 to 11 percent slopes	1,500	0.3
StF	Steinauer loam, 11 to 30 percent slopes	5,300	1.0
SuD2	Steinauer clay loam, 6 to 11 percent slopes, eroded	3,650	0.7
SuG	Steinauer clay loam, 20 to 40 percent slopes	2,200	0.4
Ua	Udorthents	120	*
Uc	Urban land-Crete-Sharpsburg complex, 0 to 2 percent slopes	4,100	0.8
UdB	Urban land-Judson complex, 1 to 3 percent slopes	1,850	0.3
Uk	Urban land-Kennebec complex, 0 to 2 percent slopes	5,500	1.0
UpC	Urban land-Pawnee-Mayberry complex, 2 to 7 percent slopes	580	0.1
Uw	Urban land-Wymore complex, 0 to 2 percent slopes	570	0.1
UxC	Urban land-Wymore-Sharpsburg complex, 2 to 7 percent slopes	10,400	1.9
Wb	Wabash silty clay, 0 to 1 percent slopes	920	0.2
Wt	Wymore silty clay loam, 0 to 1 percent slopes	7,450	1.4
WtB	Wymore silty clay loam, 1 to 3 percent slopes	6,350	1.2
WtC2	Wymore silty clay loam, 3 to 7 percent slopes, eroded	91,500	16.7
WtD	Wymore silty clay loam, 7 to 11 percent slopes	1,450	0.3
WtD3	Wymore silty clay, 5 to 9 percent slopes, severely eroded	12,700	2.3
Zc	Zoe silty clay loam, 0 to 2 percent slopes	800	0.1
Zo	Zook silt loam, 0 to 2 percent slopes	4,100	0.8
Zp	Zook silty clay loam, 0 to 2 percent slopes	2,250	0.4
	Water areas greater than 40 acres	4,800	0.9
	Water areas less than 40 acres	1,700	0.3
	Total	545,856	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield figure indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Grain sorghum		Winter wheat		Soybeans		Alfalfa hay		Bromegrass-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
BpF: Burchard-Nodaway	---	---	---	---	---	---	---	---	---	---	---	---
BrD: Burchard	60	90	65	90	35	---	27	---	2.9	5.0	4.0	10.0
BrE: Burchard	45	---	45	---	23	---	19	---	2.6	4.5	3.0	10.0
Bu: Butler	65	130	77	115	40	---	32	---	4.0	6.0	4.2	10.0
Bw: Butler	67	130	80	115	42	---	33	---	4.2	6.0	4.0	10.0
Co: Colo	92	130	90	115	42	---	38	---	5.0	6.5	5.0	13.0
Cp: Colo-Nodaway	65	95	68	90	35	---	27	---	4.5	6.0	5.0	12.0
Cr: Crete	75	125	84	120	42	---	34	---	3.9	5.8	4.0	12.0
CrB: Crete	72	120	82	115	40	---	30	---	3.5	5.5	4.0	10.0
CrC: Crete	67	110	78	105	37	---	28	---	3.0	5.0	3.8	9.5
CsB: Crete Variant	40	---	56	---	27	---	21	---	2.4	---	3.0	---
Ct: Crete	68	125	80	120	42	---	33	---	3.8	5.8	4.0	12.0
DcD: Dickinson	50	100	55	95	25	---	20	---	2.8	5.0	3.5	10.0
DcD2: Dickinson	40	95	50	90	22	---	---	---	---	---	3.0	9.0
Fm: Fillmore	55	105	65	95	32	---	25	---	3.0	5.0	4.0	10.0
GeD: Geary	60	100	68	95	33	---	30	---	3.5	5.5	4.0	10.0
GeD2: Geary	55	95	62	90	31	---	35	---	3.0	5.3	3.8	9.0
HeF: Hedville	---	---	---	---	---	---	---	---	---	---	---	---
JfC: Judson	80	130	85	120	40	---	36	---	4.5	6.3	5.0	13.0
JuC: Judson	95	130	93	115	45	---	40	---	4.8	6.8	5.0	13.0
Ke: Kennebec	100	145	100	135	47	---	44	---	5.5	7.0	5.0	13.5
Lm: Lamo	80	115	80	105	37	---	35	---	4.0	6.0	4.0	11.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Winter wheat		Soybeans		Alfalfa hay		Bromegrass-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
McD----- Malcolm	55	90	60	85	30	---	---	---	3.3	5.5	4.0	10.0
McF----- Malcolm	---	---	---	---	---	---	---	---	---	---	---	---
MeC2----- Mayberry	55	90	67	85	33	---	23	---	2.2	4.5	3.0	9.0
MeD2----- Mayberry	45	---	55	---	28	---	---	---	2.0	4.0	3.0	8.5
MhC3----- Mayberry	---	---	50	---	24	---	---	---	1.8	---	3.0	8.0
MrD----- Morrill	65	95	75	95	34	---	28	---	3.2	5.0	4.0	10.0
MrD2----- Morrill	53	90	60	90	30	---	---	---	3.0	4.5	3.8	9.0
MrE----- Morrill	45	---	44	---	20	---	---	---	2.5	4.2	3.0	10.0
No----- Nodaway	85	135	90	120	35	---	38	---	5.0	6.5	5.0	13.0
Ns----- Nodaway	---	---	---	---	---	---	---	---	---	---	---	---
PaC2----- Pawnee	55	95	70	95	35	---	25	---	2.4	4.5	3.2	9.0
PaD2----- Pawnee	45	---	60	---	28	---	20	---	2.0	4.0	3.0	8.5
PbC3----- Pawnee	---	---	51	---	24	---	---	---	1.8	---	2.8	8.0
Pt**. Pits, quarries												
Sa----- Salmo	45	90	50	85	19	---	19	---	2.4	4.5	3.0	10.0
Sb----- Salmo	---	---	---	---	---	---	---	---	---	---	---	---
Sc----- Salmo	42	90	47	80	18	---	18	---	2.3	4.2	3.0	10.0
ShC----- Sharpsburg	85	128	90	110	43	---	33	---	4.5	6.5	4.8	12.0
ShD----- Sharpsburg	75	115	84	105	40	---	30	---	4.0	6.0	4.5	11.0
ShD2----- Sharpsburg	70	110	79	100	37	---	28	---	3.5	5.5	4.2	10.0
ShE2----- Sharpsburg	55	---	60	---	30	---	21	---	3.0	5.2	4.0	9.5
Sk----- Sharpsburg	92	145	92	135	47	---	38	---	4.3	6.5	4.8	13.0
SmD----- Shelby	60	90	69	85	35	---	29	---	3.0	5.0	4.0	10.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Winter wheat		Soybeans		Alfalfa hay		Bromegrass-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
SoF----- Sogn-Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
StD----- Steinauer	50	---	60	---	30	---	23	---	2.8	4.5	3.0	8.5
StF----- Steinauer	---	---	---	---	---	---	---	---	---	---	---	---
SuD2----- Steinauer	---	---	---	---	25	---	---	---	2.5	---	3.0	8.5
SuG----- Steinauer	---	---	---	---	---	---	---	---	---	---	---	---
Ua**. Udorthents												
Uc----- Urban land-Crete-Sharpsburg	---	---	---	---	---	---	---	---	---	---	---	---
UdB----- Urban land-Judson	---	---	---	---	---	---	---	---	---	---	---	---
Uk----- Urban land-Kennebec	---	---	---	---	---	---	---	---	---	---	---	---
UpC----- Urban land-Pawnee-Mayberry	---	---	---	---	---	---	---	---	---	---	---	---
Uw----- Urban land-Wymore	---	---	---	---	---	---	---	---	---	---	---	---
UxC----- Urban land-Wymore-Sharpsburg	---	---	---	---	---	---	---	---	---	---	---	---
Wb----- Wabash	63	110	65	100	30	---	32	---	3.0	5.0	4.0	10.0
Wt----- Wymore	75	125	85	120	42	---	32	---	3.8	5.8	4.0	12.0
WtB----- Wymore	72	115	82	115	40	---	30	---	3.5	5.3	4.0	10.0
WtC2----- Wymore	67	105	77	105	37	---	27	---	3.0	5.0	3.5	9.5
WtD----- Wymore	55	---	62	---	32	---	26	---	2.6	4.5	3.2	9.0
WtD3----- Wymore	---	---	58	---	28	---	---	---	2.2	---	3.0	8.5
Zc----- Zoe	45	---	50	80	22	---	21	---	2.5	4.0	3.5	9.0
Zo----- Zook	85	130	87	120	40	---	38	---	4.5	6.0	4.8	13.0
Zp----- Zook	80	115	80	110	37	---	32	---	4.0	6.0	4.5	12.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only those potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I (N)	26,470	---	---	---
(I)	26,470	---	---	---
II (N)	133,480	80,930	31,900	20,650
(I)	63,230	10,680	31,900	20,650
III (N)	261,200	252,270	8,930	---
(I)	73,030	71,700	1,330	---
IV (N)	61,866	56,286	2,480	3,100
(I)	270,776	257,596	10,080	3,100
V (N)	2,300	---	2,300	---
VI (N)	28,450	12,160	15,900	390
VII (N)	2,200	2,200	---	---
VIII(N)	---	---	---	---

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
BpF*:					
Burchard	Silty	Favorable	4,250	Big bluestem	30
		Normal	3,250	Little bluestem	30
		Unfavorable	2,750	Sideoats grama	7
				Indiangrass	5
				Switchgrass	5
				Sedge	5
Nodaway	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,250	Little bluestem	15
		Unfavorable	3,500	Switchgrass	10
				Western wheatgrass	10
				Sideoats grama	10
				Porcupinegrass	5
				Indiangrass	5
				Kentucky bluegrass	5
				Sedge	5
BrD, BrE Burchard	Silty	Favorable	4,250	Big bluestem	35
		Normal	3,500	Little bluestem	30
		Unfavorable	2,750	Sideoats grama	10
				Indiangrass	10
				Switchgrass	5
				Sedge	5
Bu, Bw Butler	Clayey	Favorable	4,500	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	1,500	Switchgrass	12
				Tall dropseed	5
Co Colo	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,000	Switchgrass	15
		Unfavorable	4,250	Little bluestem	10
				Western wheatgrass	5
				Indiangrass	5
				Canada wildrye	5
				Sedge	5
				Kentucky bluegrass	5
Cp*:					
Colo	Subirrigated	Favorable	5,250	Big bluestem	35
		Normal	5,000	Switchgrass	15
		Unfavorable	4,000	Little bluestem	10
				Western wheatgrass	5
				Indiangrass	5
				Canada wildrye	5
				Sedge	5
				Kentucky bluegrass	5
Nodaway	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,250	Little bluestem	15
		Unfavorable	3,500	Switchgrass	10
				Western wheatgrass	10
				Porcupinegrass	10
				Indiangrass	5
				Kentucky bluegrass	5
				Sedge	5
				Sideoats grama	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Cr, CrB, CrC: Crete	Clayey	Favorable	4,500	Big bluestem	25
		Normal	3,750	Little bluestem	20
		Unfavorable	2,500	Switchgrass	15
				Western wheatgrass	10
				Sideoats grama	5
				Indiangrass	5
				Tall dropseed	5
CsB: Crete Variant	Saline Lowland	Favorable	4,000	Western wheatgrass	25
		Normal	3,000	Inland saltgrass	20
		Unfavorable	2,250	Switchgrass	15
				Slender wheatgrass	5
				Indiangrass	5
				Blue grama	5
				Tall dropseed	5
				Kentucky bluegrass	5
				Sedge	5
Ct: Crete	Clayey	Favorable	4,500	Big bluestem	23
		Normal	3,750	Little bluestem	17
		Unfavorable	2,500	Switchgrass	8
				Sideoats grama	8
				Indiangrass	6
				Western wheatgrass	5
				Tall dropseed	5
DcD, DcD2: Dickinson	Sandy	Favorable	4,000	Big bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	3,000	Switchgrass	15
				Porcupinegrass	10
				Indiangrass	5
				Sideoats grama	5
				Blue grama	5
				Tall dropseed	5
Fm: Fillmore	Clayey Overflow	Favorable	4,500	Big bluestem	20
		Normal	3,250	Western wheatgrass	20
		Unfavorable	2,500	Switchgrass	15
				Little bluestem	10
				Blue grama	10
				Indiangrass	5
				Canada wildrye	5
				Buffalograss	5
				Sedge	5
				Kentucky bluegrass	5
GeD, GeD2: Geary	Silty	Favorable	4,500	Big bluestem	25
		Normal	3,750	Little bluestem	20
		Unfavorable	3,000	Switchgrass	10
				Indiangrass	10
				Tall dropseed	5
				Stiff goldenrod	5
				Sideoats grama	5
HeF: Hedville	Shallow Sandy	Favorable	3,500	Little bluestem	35
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	5
				Indiangrass	5
				Sideoats grama	5
				Tall dropseed	5
				Blue grama	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
JfC: Judson	Silty	Favorable	5,000	Big bluestem	30
		Normal	4,250	Switchgrass	10
		Unfavorable	3,000	Little bluestem	10
				Indiangrass	5
				Porcupinegrass	5
				Western wheatgrass	5
				Sideoats grama	5
				Kentucky bluegrass	5
				Tall dropseed	5
				Sedge	5
JuC: Judson	Silty	Favorable	5,000	Big bluestem	30
		Normal	4,250	Switchgrass	10
		Unfavorable	3,000	Little bluestem	10
				Indiangrass	5
				Porcupinegrass	5
				Western wheatgrass	5
				Sideoats grama	5
				Kentucky bluegrass	5
				Tall dropseed	5
				Sedge	5
Ke: Kennebec	Silty Lowland	Favorable	5,000	Big bluestem	40
		Normal	4,500	Indiangrass	10
		Unfavorable	3,750	Switchgrass	10
				Little bluestem	10
				Kentucky bluegrass	10
				Western wheatgrass	5
				Sideoats grama	5
Lm: Lamo	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,000	Switchgrass	15
		Unfavorable	4,500	Indiangrass	10
				Western wheatgrass	10
				Little bluestem	5
				Sedge	5
				Kentucky bluegrass	5
McD, McF: Malcolm	Silty	Favorable	4,500	Big bluestem	25
		Normal	3,750	Little bluestem	20
		Unfavorable	3,000	Indiangrass	5
				Switchgrass	5
				Sideoats grama	5
				Sedge	5
				Prairie junegrass	5
				Tall dropseed	5
MeC2, MeD2: Mayberry	Clayey	Favorable	4,250	Big bluestem	20
		Normal	3,500	Little bluestem	15
		Unfavorable	2,250	Switchgrass	10
				Tall dropseed	10
				Indiangrass	5
				Sideoats grama	5
				Prairie dropseed	5
				Sedge	5
				Kentucky bluegrass	5
MhC3: Mayberry	Dense Clay	Favorable	3,250	Switchgrass	30
		Normal	2,250	Big bluestem	15
		Unfavorable	1,000	Little bluestem	10
				Tall dropseed	10
				Indiangrass	5
				Sideoats grama	5
				Kentucky bluegrass	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
MrD, MrD2, MrE, Morrill	Silty	Favorable	4,750	Big bluestem	35
		Normal	4,250	Little bluestem	25
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	5
				Sideoats grama	5
No, Ns, Nodaway	Silty Overflow	Favorable	5,250	Big bluestem	35
		Normal	5,250	Switchgrass	15
		Unfavorable	4,000	Little bluestem	10
				Indiangrass	10
				Kentucky bluegrass	5
				Sedge	5
				Sideoats grama	5
PaC2, PaD2, Pawnee	Clayey	Favorable	4,000	Big bluestem	30
		Normal	3,250	Little bluestem	25
		Unfavorable	2,000	Switchgrass	10
				Sideoats grama	10
				Tall dropseed	5
				Indiangrass	5
				Prairie dropseed	5
PbC3, Pawnee	Dense Clay	Favorable	3,250	Switchgrass	30
		Normal	2,000	Big bluestem	15
		Unfavorable	1,000	Little bluestem	10
				Tall dropseed	10
				Sideoats grama	5
				Indiangrass	5
Sa, Salmo	Saline Lowland	Favorable	4,000	Western wheatgrass	15
		Normal	3,250	Inland saltgrass	15
		Unfavorable	2,000	Fowl mannagrass	15
				Switchgrass	10
				Alkali seepweed	10
				Foxtail barley	10
				Indiangrass	5
				Sedge	5
				Fat-hen saltweed	5
				Kentucky bluegrass	5
Sb, Sc, Salmo	Saline Subirrigated	Favorable	4,500	Western wheatgrass	15
		Normal	3,750	Inland saltgrass	15
		Unfavorable	2,500	Fowl mannagrass	15
				Switchgrass	10
				Alkali seepweed	10
				Foxtail barley	10
				Indiangrass	5
				Sedge	5
				Fat-hen saltweed	5
				Kentucky bluegrass	5
ShC, ShD, ShD2, ShE2, Sk, Sharpsburg	Silty	Favorable	4,750	Big bluestem	30
		Normal	4,000	Little bluestem	15
		Unfavorable	3,000	Switchgrass	10
				Sideoats grama	5
				Indiangrass	5
				Tall dropseed	5
				Sedge	5
				Leadplant	5
				Kentucky bluegrass	5
SmD, Shelby	Silty	Favorable	4,250	Big bluestem	30
		Normal	3,750	Little bluestem	20
		Unfavorable	2,750	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
				Leadplant	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
SoF*:					
Sogn	Shallow Limy	Favorable	3,500	Little bluestem	30
		Normal	2,500	Big bluestem	20
		Unfavorable	1,500	Sideoats grama	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
Rock outcrop.					
StD, StF, SuD2, SuG Steinauer	Limy Upland	Favorable	4,000	Little bluestem	35
		Normal	3,000	Big bluestem	15
		Unfavorable	2,000	Sideoats grama	10
				Indiangrass	10
				Prairie junegrass	5
				Tall dropseed	5
				Kentucky bluegrass	5
Wb Wabash	Clayey Overflow	Favorable	4,500	Switchgrass	20
		Normal	4,000	Big bluestem	20
		Unfavorable	3,000	Indiangrass	15
				Prairie cordgrass	15
				Little bluestem	10
Wt, WtB, WtC2, WtD, WtD3 Wymore	Clayey	Favorable	4,500	Big bluestem	25
		Normal	3,500	Switchgrass	20
		Unfavorable	2,250	Little bluestem	15
				Tall dropseed	10
				Indiangrass	5
				Sideoats grama	5
Zc Zoe	Saline Lowland	Favorable	4,000	Switchgrass	20
		Normal	3,250	Inland saltgrass	20
		Unfavorable	2,000	Western wheatgrass	15
				Slender wheatgrass	10
				Indiangrass	10
				Sedge	5
				Kentucky bluegrass	5
				Blue grama	5
Zo, Zp Zook	Clayey Overflow	Favorable	4,750	Big bluestem	25
		Normal	4,000	Indiangrass	15
		Unfavorable	3,250	Switchgrass	15
				Prairie cordgrass	10
				Little bluestem	5
				Sedge	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS

[The symbol < means less than; the symbol > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
BpF*: Burchard.					
Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
BrD, BrE Burchard	Peking cotoneaster	Amur maple, autumn-olive, Amur honeysuckle.	Eastern redcedar, blue spruce.	Austrian pine, ponderosa pine, green ash, honeylocust, Scotch pine, common hackberry.	---
Bu, Bw Butler	American plum	Autumn-olive, common chokecherry, redosier dogwood.	Eastern redcedar	Honeylocust, Austrian pine, green ash, Russian mulberry, Scotch pine, silver maple.	Eastern cottonwood.
Co Colo	Redosier dogwood, American plum.	Tatarian honeysuckle, common chokecherry, autumn-olive.	Eastern redcedar, Russian mulberry.	Green ash, black walnut, Austrian pine.	Silver maple, eastern cottonwood.
Cp*: Colo	Redosier dogwood, American plum.	Tatarian honeysuckle, common chokecherry, autumn-olive.	Eastern redcedar, Russian mulberry.	Green ash, black walnut, Austrian pine.	Silver maple, eastern cottonwood.
Nodaway	Redosier dogwood, Peking cotoneaster.	Tatarian honeysuckle, Amur honeysuckle.	Eastern redcedar, Russian mulberry.	Common hackberry, Austrian pine, ponderosa pine, northern red oak.	Eastern cottonwood, silver maple.
Cr, CrB, CrC Crete	Peking cotoneaster, American plum.	Autumn-olive, Amur honeysuckle.	Eastern redcedar, green ash, common hackberry, honeylocust, Russian mulberry.	Ponderosa pine, Austrian pine, Scotch pine.	---
CsB Crete Variant	Skunkbush sumac, silver buffaloberry.	---	Eastern redcedar, Austrian pine, green ash, honeylocust.	Golden willow	Eastern cottonwood.
Ct Crete	Peking cotoneaster, American plum.	Autumn-olive, Amur honeysuckle, common chokecherry.	Eastern redcedar, green ash, common hackberry, honeylocust, Russian mulberry.	Ponderosa pine, Austrian pine, Scotch pine.	---
DeD, DeD2 Dickinson	Peking cotoneaster, American plum.	Tatarian honeysuckle, common chokecherry.	Eastern redcedar, Amur maple.	Common hackberry, green ash, ponderosa pine, Austrian pine.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Fm: Fillmore	Redosier dogwood	---	Eastern redcedar, green ash, golden willow.	Austrian pine, Scotch pine.	Eastern cottonwood.
GeD, GeD2: Geary	American plum, Peking cotoneaster.	Amur honeysuckle, Tatarian honeysuckle, skunkbush sumac, common chokecherry.	Eastern redcedar, common hackberry, osageorange.	Austrian pine, ponderosa pine.	Eastern cottonwood.
HeF. Hedville					
JfC: Judson	American plum	Autumn-olive, Amur honeysuckle.	Eastern redcedar, Russian mulberry.	Ponderosa pine, Austrian pine, Scotch pine, green ash, common hackberry, honeylocust.	Eastern cottonwood.
JuC: Judson	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, black walnut.	Eastern cottonwood, silver maple.
Ke: Kennebec	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, black walnut.	Silver maple, eastern cottonwood.
Lm: Lamo	Redosier dogwood	Common chokecherry, autumn-olive.	Eastern redcedar, Russian mulberry.	Austrian pine, green ash, honeylocust, golden willow, Scotch pine.	Eastern cottonwood, silver maple.
McD, McF: Malcolm	Peking cotoneaster, lilac.	Autumn-olive, skunkbush sumac.	Eastern redcedar, Russian mulberry.	Austrian pine, ponderosa pine, Scotch pine, green ash, honeylocust, common hackberry.	---
MeC2, MeD2, MhC3: Mayberry	Skunkbush sumac	---	Eastern redcedar, Russian-olive.	---	---
MrD, MrD2, MrE: Morrill	American plum, lilac, Peking cotoneaster.	Amur honeysuckle, Tatarian honeysuckle.	Green ash, common hackberry, Russian mulberry.	Austrian pine, Scotch pine, ponderosa pine, black walnut.	---
No, Ns: Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
PaC2, PaD2, PbC3: Pawnee	Skunkbush sumac	Eastern redcedar, Russian-olive.	---	---	---
Pt*. Pits, quarries					
Sa, Sb, Sc. Salmo	Skunkbush sumac, silver buffaloberry.	---	Eastern redcedar, Austrian pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
ShC, ShD, ShD2, ShE2, Sk---------Sharpsburg	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, Austrian pine.	Eastern cottonwood, silver maple.
SmD---------------Shelby	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, Austrian pine.	Eastern cottonwood, silver maple.
SoF*: Sogn.					
Rock outcrop.					
StD---------------Steinauer	Skunkbush sumac, Peking cotoneaster, Siberian peashrub.	---	Eastern redcedar, Russian-olive, bur oak.	Ponderosa pine, Austrian pine, Scotch pine.	---
StF. Steinauer					
SuD2--------------Steinauer	Skunkbush sumac, Peking cotoneaster, Siberian peashrub.	---	Eastern redcedar, Russian-olive, bur oak.	Ponderosa pine, Austrian pine, Scotch pine.	---
SuG. Steinauer					
Ua*. Udorthents					
Uc*: Urban land.					
Crete------------	Peking cotoneaster, American plum.	Autumn-olive, Amur honeysuckle.	Eastern redcedar, green ash, common hackberry, honeylocust, Russian mulberry.	Ponderosa pine, Austrian pine, Scotch pine.	---
Sharpsburg-------	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, Austrian pine.	Eastern cottonwood, silver maple.
UdB*: Urban land.					
Judson-----------	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, black walnut.	Eastern cottonwood, silver maple.
Uk*: Urban land.					

See footnote at end of table.

TABLE 8.--WINDBREAKS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Uk*:					
Kennebec	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Black walnut, common hackberry.	Silver maple, eastern cottonwood.
UpC*: Urban land.					
Pawnee	Skunkbush sumac	Eastern redcedar, Russian-olive.	---	---	---
Mayberry	Skunkbush sumac	---	Eastern redcedar, Russian-olive.	---	---
Uw*: Urban land.					
Wymore	Peking cotoneaster, lilac, American plum.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar	Austrian pine, ponderosa pine, Scotch pine, green ash, honeylocust.	---
UxC*: Urban land.					
Wymore	Peking cotoneaster, lilac, American plum.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar	Austrian pine, ponderosa pine, Scotch pine, green ash, honeylocust.	---
Sharpsburg	Redosier dogwood, Peking cotoneaster, lilac.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Common hackberry, Austrian pine.	Eastern cottonwood, silver maple.
Wb Wabash	Redosier dogwood, American plum, silver buffaloberry.	Tatarian honeysuckle, Amur honeysuckle, autumn-olive.	Eastern redcedar, Russian mulberry.	Green ash, black walnut, Austrian pine.	Eastern cottonwood.
Wt, WtB, WtC2, WtD, WtD3 Wymore	Peking cotoneaster, lilac, American plum.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar	Austrian pine, ponderosa pine, Scotch pine, green ash, honeylocust.	---
Zc Zoe	Skunkbush sumac, silver buffaloberry.	---	Eastern redcedar, Austrian pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.
Zo, Zp Zook	Redosier dogwood, American plum, silver buffaloberry.	Tatarian honeysuckle.	Russian mulberry	Green ash, black walnut, honeylocust, Austrian pine, Scotch pine.	Silver maple, eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9A.--ENVIRONMENTAL PLANTING GUIDE FOR TREES

Soil name and map symbol	Trees suitable for-- Shade	Ornamentals	Street borders
BpF:			
Burchard	Bur oak, common hackberry, green ash.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Nodaway	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
BrD, BrE Burchard	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Bu, Bw Butler	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.
Co Colo	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.
Cp:			
Colo	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.
Nodaway	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Cr, CrB, CrC, Ct Crete	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
CsB Crete Variant	Green ash, eastern cottonwood, locust varieties, golden willow.	Ponderosa pine, green ash, locust varieties.	Shademaster locust, skyline locust, Imperial locust, green ash.
DcD, DcD2 Dickinson	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Fm Fillmore	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.

TABLE 9A.--ENVIRONMENTAL PLANTING GUIDE FOR TREES--Continued

Soil name and map symbol	Trees suitable for-- Shade	Ornamentals	Street borders
GeD, GeD2: Geary	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
HeF: Hedville	Ponderosa pine	Ponderosa pine, juniper, Russian-olive.	Juniper.
JfC, JuC: Judson	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Ke: Kennebec	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Lm: Lamo	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.
McD: Malcolm	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
McF: Malcolm	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
MeC2, MeD2, MhC3: Mayberry	Green ash	Russian-olive, juniper, flowering crabapple.	Green ash.
MrD, MrD2, MrE: Morrill	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
No, Ns: Nodaway	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
PaC2, PaD2, PbC3: Pawnee	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Pt*. Pits, quarries			

See footnote at end of table.

TABLE 9A.--ENVIRONMENTAL PLANTING GUIDE FOR TREES--Continued

Soil name and map symbol	Trees suitable for-- Shade	Ornamentals	Street borders
Sa, Sb, Sc: Salmo	Green ash, eastern cottonwood, locust varieties, golden willow.	Ponderosa pine, green ash, locust varieties.	Shademaster locust, skyline locust, Imperial locust, green ash.
ShC, ShD, ShD2, ShE2, Sk: Sharpsburg	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
SmD: Shelby	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
SoF: Sogn	Ponderosa pine	Ponderosa pine, juniper, Russian-olive.	Juniper.
Rock outcrop.			
StD, SuD2: Steinauer	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
StF, SuG: Steinauer	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Ua*. Udorthents			
Uc: Urban land.			
Crete	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Sharpsburg	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
UdB: Urban land.			
Judson	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Uk: Urban land.			

See footnote at end of table.

TABLE 9A.--ENVIRONMENTAL PLANTING GUIDE FOR TREES--Continued

Soil name and map symbol	Trees suitable for-- Shade	Ornamentals	Street borders
Uk:			
Kennebec	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
UpC: Urban land.			
Pawnee	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Mayberry	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Uw: Urban land.			
Wymore	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
UxC: Urban land.			
Wymore	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Sharpsburg	Sugar maple, silver maple, northern red oak, common hackberry, green ash, American basswood.	Eastern redbud, ginkgo, flowering crabapple, white pine, blue spruce, Scotch pine.	Pin oak, Norway maple, common hackberry, eastern hophornbeam, shademaster locust.
Wb: Wabash	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.
Wt, WtB, WtC2, WtD, WtD3: Wymore	Bur oak, common hackberry, green ash.	Austrian pine, Scotch pine, juniper, Russian-olive, ponderosa pine.	Common hackberry, green ash, eastern hophornbeam.
Zc: Zoe	Green ash, eastern cottonwood, locust varieties, golden willow.	Ponderosa pine, green ash, locust varieties.	Shademaster locust, skyline locust, Imperial locust, green ash.
Zo, Zp: Zook	Silver maple, American sycamore, green ash, eastern cottonwood, scarlet oak.	Austrian pine, Scotch pine, Black Hills spruce, American sycamore, golden willow.	Shademaster locust, green ash, common hackberry.

*Onsite investigation is needed before plantings are selected.

TABLE 9B.--ENVIRONMENTAL PLANTING GUIDE FOR TREES AND SHRUBS

Soil name and map symbol	Trees and shrubs suitable for--		
	Wildlife food and cover	Hedges	Screens
BpF:			
Burchard	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Nodaway	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
BrD, BrE Burchard	Autumn olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Bu, Bw Butler	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.
Co Colo	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.
Cp:			
Colo	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.
Nodaway	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, Eastern hemlock, viburnum privet, euonymus cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Cr, CrB, CrC, Ct Crete	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
CsB Crete Variant	Skunkbush sumac, silver buffaloberry, eastern redcedar, American elderberry.	Skunkbush sumac, redosier dogwood.	Eastern redcedar, Austrian pine.
DcD, DcD2 Dickinson	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Fm Fillmore	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.

TABLE 9B.--ENVIRONMENTAL PLANTING GUIDE FOR TREES AND SHRUBS--Continued

Soil name and map symbol	Trees and shrubs suitable for--		
	Wildlife food and cover	Hedges	Screens
GeD, GeD2 Geary	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
HeF Hedville	Eastern redcedar, skunkbush sumac.	Lilac, eastern redcedar.	Eastern redcedar, Russian-olive.
JfC, JuC Judson	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Ke Kennebec	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Lm Lamo	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.
McD Malcolm	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, Ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
McF Malcolm	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
MeC2, MeD2, MhC3 Mayberry	Skunkbush sumac, eastern redcedar.	Eastern redcedar	Eastern redcedar, Russian-olive.
MrD, MrD2, MrE Morrill	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
No, Ns Nodaway	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
PaC2, PaD2, PbC3 Pawnee	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Pt*. Pits, quarries			

See footnote at end of table.

TABLE 9B.--ENVIRONMENTAL PLANTING GUIDE FOR TREES AND SHRUBS--Continued

Soil name and map symbol	Trees and shrubs suitable for-- Wildlife food and cover	Hedges	Screens
Sa, Sb, Sc: Salmo	Skunkbush sumac, silver buffaloberry, eastern redcedar, American elderberry.	Skunkbush sumac, redosier dogwood.	Eastern redcedar, Austrian pine.
ShC, ShD, ShD2, ShE2, Sk: Sharpsburg	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
SmD: Shelby	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
SoF: Sogn	Eastern redcedar, skunkbush sumac.	Lilac, eastern redcedar.	Eastern redcedar, Russian-olive.
Rock outcrop.			
StD, SuD2: Steinauer	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
StF, SuG: Steinauer	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Ua*. Udorthents			
Uc: Urban land.			
Crete	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Sharpsburg	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
UdB: Urban land.			
Judson	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Uk: Urban land.			

See footnote at end of table.

TABLE 9B.--ENVIRONMENTAL PLANTING GUIDE FOR TREES AND SHRUBS--Continued

Soil name and map symbol	Trees and shrubs suitable for-- Wildlife food and cover	Hedges	Screens
Uk:			
Kennebec	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
UpC:			
Urban land.			
Pawnee	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Mayberry	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush, sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Uw:			
Urban land.			
Wymore	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
UxC:			
Urban land.			
Wymore	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Sharpsburg	Autumn-olive, honeysuckle, Nanking cherry, crabapple, skunkbush sumac, snowberry.	Lilac, eastern hemlock, viburnum, privet, euonymus, cotoneaster.	Eastern redcedar, ponderosa pine, Norway spruce, upright juniper, arborvitae, Lombardy poplar.
Wb Wabash	Autumn-olive, American plum, common chokecherry. silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.
Wt, WtB, WtC2, WtD, WtD3 Wymore	Skunkbush sumac, eastern redcedar, Russian-olive.	Lilac, Siberian peashrub, skunkbush sumac, cotoneaster.	Eastern redcedar, Russian-olive, Austrian pine, ponderosa pine.
Zc Zoe	Skunkbush sumac, silver buffaloberry, eastern redcedar, American elderberry.	Skunkbush sumac, redosier dogwood.	Eastern redcedar, Austrian pine.
Zo, Zp Zook	Autumn-olive, American plum, common chokecherry, silver buffaloberry.	Lilac, cotoneaster	Eastern redcedar, Austrian pine, Scotch pine, autumn-olive.

*Onsite investigation is needed before plantings are selected.

TABLE 9C.--ENVIRONMENTAL PLANTING GUIDE FOR GRASSES

Soil name and map symbol	Grasses suitable for-- Lawns	Roadsides, steep banks	Recreation areas
BpF:			
Burchard	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Nodaway	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
BrD, BrE Burchard	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Bu, Bw Butler	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
Co Colo	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
Cp:			
Colo	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
Nodaway	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Cr, CrB, CrC, Ct Crete	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
CsB Crete Variant	Tall fescue	Switchgrass, western wheatgrass.	Tall fescue, western wheatgrass, birdsfoot trefoil, red clover.
DcD, DcD2 Dickinson	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Fm Fillmore	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
GeD, GeD2 Geary	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
HeF Hedville	Kentucky bluegrass, blue grama.	Switchgrass, sideoats grama, blue grama.	Blue grama, western wheatgrass, little bluestem.
JfC, JuC Judson	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.

TABLE 9C.--ENVIRONMENTAL PLANTING GUIDE FOR GRASSES--Continued

Soil name and map symbol	Grasses best suited for-- Lawns	Roadsides, steep banks	Recreation areas
Ke-------- Kennebec	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Lm-------- Lamo	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
McD-------- Malcolm	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
McF-------- Malcolm	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
MeC2, MeD2, MhC3-------- Mayberry	Tall fescue, blue grama, buffalograss.	Switchgrass, tall fescue, crownvetch.	Tall fescue, buffalograss, blue grama.
MrD, MrD2, MrE-------- Morrill	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
No, Ns-------- Nodaway	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
PaC2, PaD2, PbC3-------- Pawnee	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Pt*. Pits, quarries			
Sa, Sb, Sc-------- Salmo	Tall fescue--------	Switchgrass, western wheatgrass.	Tall fescue, western wheatgrass, birdsfoot trefoil, red clover.
ShC, ShD, ShD2, ShE2, Sk-- Sharpsburg	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
SmD-------- Shelby	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
SoF-------- Sogn	Kentucky bluebrass, blue grama.	Switchgrass, sideoats grama, blue grama.	Blue grama, western wheatgrass, little bluestem.
Rock outcrop.			

See footnote at end of table.

TABLE 9C.--ENVIRONMENTAL PLANTING GUIDE FOR GRASSES--Continued

Soil name and map symbol	Grasses best suited for--		
	Lawns	Roadsides, steep banks	Recreation areas
StD, SuD2: Steinauer	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
StF, SuG: Steinauer	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Ua*. Udorthents			
Uc: Urban land.			
Crete	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Sharpsburg	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
UdB: Urban land.			
Judson	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Uk: Urban land.			
Uk: Kennebec	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
UpC: Urban land.			
Pawnee	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Mayberry	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Uw: Urban land.			
Wymore	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
UxC: Urban land.			

See footnote at end of table.

TABLE 9C.--ENVIRONMENTAL PLANTING GUIDE FOR GRASSES--Continued

Soil name and map symbol	Grasses best suited for-- Lawns	Roadsides, steep banks	Recreation areas
UxC:			
Wymore	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Sharpsburg	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Wb Wabash	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot trefoil, red clover.
Wt, WtB, WtC2, WtD, WtD3 Wymore	Kentucky bluegrass, tall fescue, blue grama, buffalograss.	Switchgrass, blue grama, sideoats grama, bromegrass, tall fescue, crownvetch.	Tall fescue, blue grama, sideoats grama, buffalograss.
Zc Zoe	Tall fescue	Switchgrass, western wheatgrass.	Tall fescue, western wheatgrass, birdsfoot trefoil, red clover.
Zo, Zp Zook	Kentucky bluegrass, tall fescue.	Switchgrass, tall fescue, reed canarygrass.	Tall fescue, birdsfoot. trefoil, red clover.

*Onsite investigation is needed before plantings are selected.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
BpF*:					
Burchard	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.
Nodaway	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
BrD, BrE Burchard	Moderate: percs slowly, slope.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey, slope.
Bu, Bw Butler	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
Co Colo	Severe: floods.	Moderate: wetness.	Moderate: wetness, floods.	Slight	Moderate: floods.
Cp*:					
Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
Nodaway	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
Cr Crete	Moderate: percs slowly.	Slight	Slight	Slight	Slight.
CrB, CrC Crete	Moderate: percs slowly.	Slight	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
CsB Crete Variant	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: excess sodium.
Ct Crete	Moderate: percs slowly.	Slight	Slight	Slight	Slight.
DcD, DcD2 Dickinson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Fm Fillmore	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
GeD, GeD2 Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, too clayey.
HeF Hedville	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
JfC Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
JuC Judson	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ke------------------- Kennebec	Severe: floods.	Slight----------	Moderate: floods.	Slight------------	Moderate: floods.
Lm------------------- Lamo	Severe: floods.	Moderate: too clayey, wetness.	Moderate: too clayey, wetness, floods.	Moderate: too clayey.	Moderate: floods, too clayey.
McD------------------ Malcolm	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
McF------------------ Malcolm	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MeC2----------------- Mayberry	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
MeD2----------------- Mayberry	Moderate: percs slowly, slope.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey, slope.
MhC3----------------- Mayberry	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
MrD, MrD2, MrE-------- Morrill	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: slope, too clayey.
No, Ns--------------- Nodaway	Severe: floods.	Slight----------	Moderate: floods.	Slight------------	Moderate: floods.
PaC2----------------- Pawnee	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
PaD2----------------- Pawnee	Moderate: percs slowly, too clayey.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey, slope.
PbC3----------------- Pawnee	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Pt*. Pits, quarries					
Sa------------------- Salmo	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Moderate: too clayey.	Severe: excess salt.
Sb------------------- Salmo	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: excess salt, floods.
Sc------------------- Salmo	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: excess salt.
ShC------------------ Sharpsburg	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
ShD, ShD2------------ Sharpsburg	Moderate: percs slowly.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey.
ShE2----------------- Sharpsburg	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey, slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Sk: Sharpsburg	Moderate: percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
SmD: Shelby	Moderate: slope, percs slowly.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey.
SoF*:					
Sogn	Severe: slope, depth to rock.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: thin layer, slope.
Rock outcrop.					
StD: Steinauer	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
StF: Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
SuD2: Steinauer	Moderate: percs slowly, slope.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey.
SuG: Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ua*. Udorthents					
Uc*: Urban land.					
Crete	Moderate: percs slowly.	Slight	Slight	Slight	Slight.
Sharpsburg	Moderate: percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
UdB*: Urban land.					
Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
Uk*: Urban land.					
Kennebec	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
UpC*: Urban land.					
Pawnee	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
Mayberry	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
Uw*: Urban land.					
Wymore	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
UxC*: Urban land.					
Wymore	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
Sharpsburg	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
Wb: Wabash	Severe: floods, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: too clayey, wetness.
Wt, WtB: Wymore	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
WtC2: Wymore	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
WtD: Wymore	Moderate: slope, too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey, slope.
WtD3: Wymore	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.	Severe: too clayey.
Zc: Zoe	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness, floods.
Zo: Zook	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Zp: Zook	Severe: wetness, floods.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
BpF*:												
Burchard	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Nodaway	Good	Good	Good	Good	Fair	Good	Fair	Poor	Fair	Good	Fair	Good.
BrD, BrE Burchard	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Bu, Bw Butler	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Co Colo	Good	Fair	Good	Fair	Poor	Good	Fair	Fair	Fair	Fair	Fair	Good.
Cp*:												
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Good	Fair	Fair	Good	Good.
Nodaway	Good	Good	Good	Good	Fair	Good	Fair	Poor	Fair	Good	Fair	Good.
Cr, CrB Crete	Good	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
CrC Crete	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
CsB Crete Variant	Fair	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Ct Crete	Good	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
DcD, DcD2 Dickinson	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Fm Fillmore	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair.
GeD, GeD2 Geary	Fair	Good	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
HeF Hedville	Very poor.	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor.
JfC Judson	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
JuC Judson	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Ke Kennebec	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Lm Lamo	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
McD Malcolm	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
McF Malcolm	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
MeC2, MeD2, MhC3--- Mayberry	Fair	Good	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
MrD, MrD2, MrE----- Morrill	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
No, Ns------------- Nodaway	Good	Good	Good	Good	Fair	Good	Fair	Poor	Fair	Good	Fair	Good.
PaC2, PaD2--------- Pawnee	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Poor	Fair.
PbC3--------------- Pawnee	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Good	Fair	Fair	Poor	Fair.
Pt*. Pits, quarries												
Sa----------------- Salmo	Poor	Fair	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Fair.
Sb, Sc------------- Salmo	Very poor.	Poor	Fair	Poor	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair.
ShC---------------- Sharpsburg	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
ShD, ShD2, ShE2---- Sharpsburg	Fair	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Sk----------------- Sharpsburg	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
SmD---------------- Shelby	Fair	Good	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor	Good.
SoF*: Sogn---------------	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Rock outcrop.												
StD---------------- Steinauer	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
StF---------------- Steinauer	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
SuD2--------------- Steinauer	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
SuG---------------- Steinauer	Very poor.	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Good.
Ua*. Udorthents												
Uc*: Urban land.												
Crete.												
Sharpsburg.												
UdB*: Urban land.												
Judson.												

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Uk*:												
Urban land.												
Kennebec.												
UpC*:												
Urban land.												
Pawnee.												
Mayberry.												
Uw*:												
Urban land.												
Wymore.												
UxC*:												
Urban land.												
Wymore.												
Sharpsburg.												
Wb------------------ Wabash	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Good	Poor	Poor	Fair	---
Wt, WtB------------ Wymore	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
WtC2, WtD, WtD3----- Wymore	Fair	Good	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Zc------------------ Zoe	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Poor	Poor	Good	Fair.
Zo, Zp-------------- Zook	Good	Fair	Good	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BpF*:						
Burchard	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.	Severe: floods.
BrD, BrE Burchard	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: too clayey, slope.
Bu, Bw Butler	Severe: wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, floods, wetness.	Moderate: wetness, floods.
Co Colo	Severe: floods.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, low strength, shrink-swell.	Moderate: floods.
Cp*:						
Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Severe: floods.
Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.	Severe: floods.
Cr Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
CrB, CrC Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: too clayey.
CsB Crete Variant	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: excess sodium.
Ct Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
DcD, DcD2 Dickinson	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Fm Fillmore	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.	Severe: wetness.
GeD, GeD2 Geary	Moderate: slope.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope, too clayey.
HeF Hedville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
JfC-Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
JuC-Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
Ke-Kennebec	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Moderate: floods.
Lm-Lamo	Severe: wetness, floods.	Severe: low strength, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: low strength, floods, shrink-swell.	Severe: floods, low strength, frost action.	Moderate: floods, too clayey.
McD-Malcolm	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
McF-Malcolm	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
MeC2-Mayberry	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey.
MeD2-Mayberry	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey, slope.
MhC3-Mayberry	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Severe: too clayey.
MrD, MrD2, MrE-Morrill	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope, too clayey.
No, Ns-Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.	Moderate: floods.
PaC2-Pawnee	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.	Moderate: too clayey.
PaD2-Pawnee	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, frost action.	Moderate: too clayey, slope.
PbC3-Pawnee	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
Pt*. Pits, quarries						

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sa---------------- Salmo	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, low strength.	Severe: excess salt.
Sb---------------- Salmo	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: excess salt, floods.
Sc---------------- Salmo	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: excess salt.
ShC, ShD, ShD2---- Sharpsburg	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: frost action, low strength.	Moderate: too clayey.
ShE2-------------- Sharpsburg	Moderate: slope, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: frost action, low strength.	Moderate: too clayey, slope.
Sk---------------- Sharpsburg	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: frost action, low strength.	Moderate: too clayey.
SmD--------------- Shelby	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: too clayey.
SoF*:						
Sogn-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: thin layer, slope.
Rock outcrop.						
StD--------------- Steinauer	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
StF--------------- Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
SuD2-------------- Steinauer	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: too clayey.
SuG--------------- Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
Ua*. Udorthents						
Uc*: Urban land.						
Crete------------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Uc*:						
Sharpsburg	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: frost action, low strength.	Moderate: too clayey.
UdB*:						
Urban land.						
Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
Uk*:						
Urban land.						
Kennebec	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Moderate: floods.
UpC*:						
Urban land.						
Pawnee	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.	Moderate: too clayey.
Mayberry	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey.
Uw*:						
Urban land.						
Wymore	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey.
UxC*:						
Urban land.						
Wymore	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey.
Sharpsburg	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: frost action, low strength.	Moderate: too clayey.
Wb: Wabash	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.	Severe: too clayey, wetness.
Wt, WtB, WtC2: Wymore	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey.
WtD: Wymore	Moderate: too clayey, slope.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, frost action, low strength.	Moderate: too clayey, slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WtD3--------------- Wymore	Moderate: too clayey, slope.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, frost action, low strength.	Severe: too clayey.
Zc----------------- Zoe	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, low strength.	Moderate: wetness, floods.
Zo, Zp------------ Zook	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BpF*:					
Burchard	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
BrD, BrE Burchard	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Bu, Bw Butler	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Co Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
Cp*:					
Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
Cr Crete	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
CrB, CrC Crete	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
CsB Crete Variant	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Fair: too clayey.
Ct Crete	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
DcD, DcD2 Dickinson	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Fm Fillmore	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, too clayey, wetness.	Severe: floods, wetness.	Poor: wetness, too clayey.
GeD, GeD2 Geary	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
HeF Hedville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope, depth to rock.	Poor: thin layer, area reclaim.
JfC Judson	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
JuC: Judson	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Ke: Kennebec	Severe: floods	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Lm: Lamo	Severe: percs slowly, wetness, floods.	Severe: floods, wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
McD: Malcolm	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
McF: Malcolm	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
MeC2: Mayberry	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
MeD2: Mayberry	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
MhC3: Mayberry	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
MrD, MrD2, MrE: Morrill	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
No, Ns: Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
PaC2: Pawnee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
PaD2: Pawnee	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
PbC3: Pawnee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Pt*. Pits, quarries					
Sa: Salmo	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: too clayey.
Sb, Sc: Salmo	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
ShC: Sharpsburg	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
ShD, ShD2: Sharpsburg	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey.
ShE2: Sharpsburg	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
Sk: Sharpsburg	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SmD: Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
SoF*:					
Sogn	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
StD: Steinauer	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
StF: Steinauer	Severe: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
SuD2: Steinauer	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
SuG: Steinauer	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ua*. Udorthents					
Uc*:					
Urban land.					
Crete	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Sharpsburg	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
UdB*:					
Urban land.					
Judson	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Uk*:					
Urban land.					
Kennebec	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
UpC*:					
Urban land.					
Pawnee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Mayberry	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Uw*:					
Urban land.					
Wymore	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
UxC*: Urban land.					
Wymore	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Sharpsburg	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Wb Wabash	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Wt, WtB Wymore	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
WtC2 Wymore	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
WtD, WtD3 Wymore	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Zc Zoe	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.
Zo, Zp Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
BpF*:				
Burchard	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Nodaway	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
BrD, BrE Burchard	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Bu, Bw Butler	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Co Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cp*:				
Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Nodaway	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cr Crete	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
CrB, CrC Crete	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
CsB Crete Variant	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium.
Ct Crete	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
DcD, DcD2 Dickinson	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: slope.
Fm Fillmore	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
GeD, GeD2 Geary	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
HeF Hedville	Poor: thin layer, area reclaim.	Unsuited: thin layer.	Unsuited: thin layer.	Poor: area reclaim, slope.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
JfC------------------- Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
JuC------------------- Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ke-------------------- Kennebec	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Lm-------------------- Lamo	Poor: shrink-swell, frost action, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
McD------------------- Malcolm	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
McF------------------- Malcolm	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
MeC2, MeD2, MhC3------ Mayberry	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
MrD, MrD2, MrE-------- Morrill	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
No, Ns---------------- Nodaway	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
PaC2------------------ Pawnee	Poor: shrink-swell, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, thin layer.
PaD2------------------ Pawnee	Poor: shrink-swell, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, thin layer, slope.
PbC3------------------ Pawnee	Poor: shrink-swell, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Pt*. Pits, quarries				
Sa-------------------- Salmo	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, wetness.
Sb, Sc---------------- Salmo	Severe: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
ShC, ShD, ShD2-------- Sharpsburg	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
ShE2------------------ Sharpsburg	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Sk-------------------- Sharpsburg	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SmD: Shelby	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
SoF*:				
Sogn	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, slope.
Rock outcrop.				
StD: Steinauer	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
StF: Steinauer	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
SuD2: Steinauer	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
SuG: Steinauer	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Ua*. Udorthents				
Uc*:				
Urban land.				
Crete	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Sharpsburg	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
UdB*:				
Urban land.				
Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Uk*:				
Urban land.				
Kennebec	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
UpC*:				
Urban land.				
Pawnee	Poor: shrink-swell, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Mayberry	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Uw*:				
Urban land.				

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Uw*:				
Wymore	Poor: shrink-swell, frost action, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
UxC*:				
Urban land.				
Wymore	Poor: shrink-swell, frost action, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Sharpsburg	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Wb Wabash	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.
Wt, WtB, WtC2, WtD, WtD3 Wymore	Poor: shrink-swell, frost action, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Zc Zoe	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, excess salt.
Zo Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Zp Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
BpF*:						
Burchard	Slope	Favorable	Not needed	Slope	Slope	Slope.
Nodaway	Seepage	Favorable	Not needed	Floods, erodes easily.	Not needed	Erodes easily.
BrD Burchard	Slope	Favorable	Not needed	Slope	Favorable	Slope.
BrE Burchard	Slope	Favorable	Not needed	Slope	Slope	Slope.
Bu, Bw Butler	Favorable	Hard to pack, wetness.	Percs slowly, frost action, floods.	Percs slowly, wetness.	Not needed	Wetness, percs slowly, erodes easily.
Co Colo	Seepage	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness	Wetness.
Cp*:						
Colo	Seepage	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness	Wetness.
Nodaway	Seepage	Favorable	Not needed	Floods, erodes easily.	Not needed	Erodes easily.
Cr, CrB, CrC Crete	Favorable	Hard to pack	Not needed	Percs slowly, erodes easily.	Percs slowly	Percs slowly, erodes easily.
CsB Crete Variant	Seepage	Hard to pack, piping.	Not needed	Erodes easily, excess sodium, percs slowly.	Percs slowly	Percs slowly, excess sodium, erodes easily.
Ct Crete	Favorable	Hard to pack	Not needed	Percs slowly, erodes easily.	Percs slowly	Percs slowly, erodes easily.
DcD, DcD2 Dickinson	Slope, seepage.	Seepage	Not needed	Soil blowing, slope.	Soil blowing, too sandy.	Slope.
Fm Fillmore	Favorable	Wetness	Percs slowly, frost action, floods.	Wetness, percs slowly.	Not needed	Wetness, erodes easily, percs slowly.
GeD, GeD2 Geary	Seepage, slope.	Favorable	Not needed	Slope	Erodes easily	Slope, erodes easily.
HeF Hedville	Slope, depth to rock.	Thin layer	Not needed	Slope, rooting depth, droughty.	Slope, depth to rock.	Slope, droughty, rooting depth.
JfC Judson	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Favorable.
JuC Judson	Seepage	Favorable	Not needed	Favorable	Erodes easily	Erodes easily.
Ke Kennebec	Seepage	Favorable	Floods, frost action.	Floods	Erodes easily	Erodes easily.
Lm Lamo	Favorable	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed	Favorable.
McD Malcolm	Slope, seepage.	Piping	Not needed	Slope	Erodes easily	Slope, erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
McF: Malcolm	Slope, seepage.	Piping	Not needed	Slope	Slope, erodes easily.	Slope, erodes easily.
MeC2: Mayberry	Favorable	Hard to pack	Not needed	Percs slowly	Percs slowly	Percs slowly, erodes easily.
MeD2	Slope	Hard to pack	Not needed	Percs slowly, slope.	Percs slowly	Slope, percs slowly, erodes easily.
MhC3: Mayberry	Favorable	Hard to pack	Not needed	Slow intake, percs slowly.	Percs slowly	Percs slowly, erodes easily.
MrD, MrD2: Morrill	Slope	Favorable	Not needed	Slope	Favorable	Slope, erodes easily.
MrE: Morrill	Slope	Favorable	Not needed	Slope	Slope	Slope, erodes easily.
No, Ns: Nodaway	Seepage	Favorable	Not needed	Floods, erodes easily.	Not needed	Erodes easily.
PaC2: Pawnee	Favorable	Hard to pack	Not needed	Percs slowly, erodes easily.	Percs slowly	Percs slowly, erodes easily.
PaD2: Pawnee	Slope	Hard to pack	Not needed	Percs slowly, erodes easily.	Percs slowly	Slope, percs slowly.
PbC3: Pawnee	Favorable	Hard to pack	Not needed	Slow intake, percs slowly, erodes easily.	Percs slowly	Percs slowly. erodes easily.
Pt*. Pits, quarries						
Sa: Salmo	Favorable	Wetness	Floods, excess salt, frost action.	Excess salt, floods, wetness.	Not needed	Excess salt.
Sb, Sc: Salmo	Favorable	Wetness	Floods, excess salt, frost action.	Excess salt, floods, wetness.	Not needed	Excess salt.
ShC: Sharpsburg	Favorable	Hard to pack	Not needed	Favorable	Erodes easily	Erodes easily.
ShD, ShD2: Sharpsburg	Slope, seepage.	Hard to pack	Not needed	Slope	Erodes easily	Erodes easily.
ShE2: Sharpsburg	Slope, seepage.	Hard to pack	Not needed	Slope	Slope, erodes easily.	Slope, erodes easily.
Sk: Sharpsburg	Favorable	Hard to pack	Not needed	Favorable	Not needed	Erodes easily.
SmD: Shelby	Slope	Favorable	Not needed	Slope	Favorable	Erodes easily, slope.
SoF*: Sogn	Slope, depth to rock.	Thin layer	Not needed	Rooting depth, slope.	Depth to rock, slope.	Slope, rooting depth.
Rock outcrop.						
StD: Steinauer	Slope, seepage.	Favorable	Not needed	Slope	Favorable	Slope.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservior areas	Embankments, dikes, and levees	Drainage	Irrigation	Terrabes and diversions	Grassed waterways
StF-------------- Steinauer	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
SuD2------------- Steinauer	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Favorable------	Slope.
SuG-------------- Steinauer	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
Ua*. Udorthents						
Uc*: Urban land.						
Crete------------	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Percs slowly---	Percs slowly, erodes easily.
Sharpsburg-------	Favorable------	Hard to pack---	Not needed-----	Favorable------	Not needed-----	Erodes easily.
UdB*: Urban land.						
Judson-----------	Seepage--------	Favorable------	Not needed-----	Favorable------	Erodes easily	Erodes easily.
Uk*: Urban land.						
Kennebec---------	Seepage--------	Favorable------	Floods, frost action.	Floods---------	Erodes easily	Erodes easily.
UpC*: Urban land.						
Pawnee-----------	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Percs slowly---	Percs slowly, erodes easily.
Mayberry---------	Favorable------	Hard to pack---	Not needed-----	Percs slowly---	Percs slowly---	Percs slowly, erodes easily.
Uw*: Urban land.						
Wymore-----------	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Not needed-----	Percs slowly, erodes easily.
UxC*: Urban land.						
Wymore-----------	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Percs slowly---	Percs slowly, erodes easily.
Sharpsburg-------	Favorable------	Hard to pack---	Not needed-----	Favorable------	Erodes easily	Erodes easily.
Wb--------------- Wabash	Favorable------	Wetness, hard to pack.	Floods, percs slowly.	Wetness, slow intake, percs slowly.	Not needed-----	Percs slowly, wetness.
Wt, WtB---------- Wymore	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Not needed-----	Percs slowly, erodes easily.
WtC2------------- Wymore	Favorable------	Hard to pack---	Not needed-----	Percs slowly, erodes easily.	Percs slowly---	Percs slowly, erodes easily.
WtD-------------- Wymore	Slope----------	Hard to pack---	Not needed-----	Erodes easily, slope, percs slowly.	Percs slowly---	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Zc: Zoe	Favorable	Hard to pack, wetness, piping.	Percs slowly, floods, frost action.	Wetness, excess salt, percs slowly.	Not needed	Wetness, percs slowly.
Zo, Zp: Zook	Favorable	Hard to pack, wetness.	Floods, percs slowly, frost action.	Floods, wetness, percs slowly.	Not needed	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; the symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
BpF*:											
Burchard----------	0-8	Clay loam-------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	8-33	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	65-80	35-50	20-30
	33-60	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	60-80	35-50	15-30
Nodaway-----------	0-60	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
BrD, BrE----------- Burchard	0-8	Clay loam-------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	8-33	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	65-80	35-50	20-30
	33-60	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	60-80	35-50	15-30
Bu, Bw------------- Butler	0-12	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	20-40	5-15
	12-34	Clay, silty clay	CH	A-7	0	100	100	100	95-100	50-70	30-45
	34-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-60	15-35
Co----------------- Colo	0-12	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	12-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Cp*:											
Colo--------------	0-12	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	12-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Nodaway-----------	0-60	Silty clay loam	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Cr----------------- Crete	0-8	Silt loam-------	CL	A-4, A-6	0	100	100	100	95-100	30-40	8-15
	8-31	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	31-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
CrB, CrC----------- Crete	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-30
	11-35	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	35-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
CsB---------------- Crete Variant	0-6	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	6-20	Silty clay------	CH	A-7	0	100	100	100	95-100	50-65	27-42
	20-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	18-30
Ct----------------- Crete	0-13	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	100	95-100	30-40	8-15
	13-31	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	31-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
DcD, DcD2---------- Dickinson	0-12	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	12-30	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	30-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Fm: Fillmore	0-16	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	16-48	Silty clay	CH	A-7	0	100	100	100	95-100	50-75	30-45
	48-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
GeD, GeD2: Geary	0-12	Silty clay loam	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	12-37	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	37-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-20
HeF: Hedville	0-16	Sandy loam, loamy sand.	SM, ML, SC, CL	A-4, A-2	0-30	70-100	70-100	50-85	15-70	<26	NP-8
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
JfC: Judson	0-15	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	25-35	25-35	2-8
	15-60	Loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	85-95	60-75	20-30	5-12
JuC: Judson	0-29	Silt loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	29-60	Silty clay loam	CL, CL-ML	A-6, A-7	0	100	100	100	95-100	25-50	5-25
Ke: Kennebec	0-45	Silt loam	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	45-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
Lm: Lamo	0-29	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	85-95	40-65	14-35
	29-60	Silty clay loam, silty clay.	CL, CH, ML, MH	A-7, A-6	0	100	100	95-100	85-95	35-60	10-35
McD, McF: Malcolm	0-10	Silt loam	CL	A-4, A-6	0	100	100	90-100	70-90	25-35	7-17
	10-28	Silty clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-40	3-18
	28-60	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	55-100	20-35	3-15
MeC2, MeD2: Mayberry	0-12	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	75-100	35-45	15-25
	12-48	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	90-100	80-100	60-100	45-60	25-35
	48-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	95-100	85-95	70-95	35-60	15-30
MhC3: Mayberry	0-6	Clay	CH	A-7	0	100	100	90-100	90-100	45-60	25-35
	6-37	Clay	CL, CH	A-7	0	100	90-100	80-100	60-100	45-60	25-35
	37-60	Clay	CL, CH	A-6, A-7	0	95-100	95-100	85-95	70-95	35-60	15-30
MrD, MrD2, MrE: Morrill	0-8	Clay loam	ML, CL, CL-ML	A-4, A-6	0	100	100	94-100	50-85	20-35	2-15
	8-32	Clay loam, sandy clay loam.	CL	A-4, A-6, A-7	0	100	100	90-100	55-85	30-45	8-20
	32-60	Loam, clay loam, sandy loam.	CL, ML	A-4, A-6	0	100	100	90-100	55-85	25-40	2-15

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
No, Ns------------- Nodaway	0-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
PaC2, PaD2--------- Pawnee	0-7	Clay loam-------	CL	A-6	0	95-100	95-100	85-100	70-90	30-40	10-20
	7-38	Clay------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	38-60	Clay loam-------	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
PbC3--------------- Pawnee	0-6	Clay------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	6-30	Clay------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	30-60	Clay loam-------	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
Pt*. Pits, quarries											
Sa----------------- Salmo	0-18	Silt loam-------	ML, CL	A-4, A-6	0	100	100	90-100	70-95	25-40	7-15
	18-43	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	10-20
	43-60	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-95	35-50	10-25
Sb, Sc------------- Salmo	0-15	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	10-20
	15-24	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	10-20
	24-60	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-95	35-50	10-25
ShC, ShD, ShD2, ShE2-------------- Sharpsburg	0-7	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	7-44	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-60	20-35
	44-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
Sk----------------- Sharpsburg	0-11	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	11-40	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-60	20-35
	40-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
SmD---------------- Shelby	0-13	Clay loam-------	CL	A-6	0	90-100	85-98	75-90	55-70	30-40	11-20
	13-55	Clay loam-------	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-45	15-25
	55-60	Clay loam-------	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-45	15-25
SoF*: Sogn--------------	0-9	Silty clay loam	CL	A-6, A-7	0-10	85-100	85-100	85-100	70-95	25-45	11-23
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
StD, StF----------- Steinauer	0-5	Loam------------	CL-ML, CL	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-70	25-45	4-20
	5-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	90-100	60-75	20-45	10-26
SuD2, SuG---------- Steinauer	0-6	Clay loam-------	CL	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-50	15-25
	6-60	Clay loam-------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
Ua*. Udorthents											
Uc*: Urban land.											

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Uc*:											
Crete-------------	0-8	Silt loam-------	CL	A-4, A-6	0	100	100	100	95-100	30-40	8-15
	8-31	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	31-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
Sharpsburg--------	0-14	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	14-48	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-60	20-35
	48-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
UdB*:											
Urban land.											
Judson------------	0-28	Silt loam-------	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	28-60	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
Uk*:											
Urban land.											
Kennebec----------	0-36	Silt loam-------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	36-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
UpC*:											
Urban land.											
Pawnee------------	0-10	Clay loam-------	CL	A-6	0	95-100	95-100	85-100	70-90	30-40	10-20
	10-30	Clay------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	30-60	Clay loam-------	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
Mayberry----------	0-12	Clay loam-------	CL	A-6, A-7	0	100	95-100	90-100	75-100	35-45	15-25
	12-48	Clay, silty clay, sandy clay.	CL, CH	A-7	0	100	90-100	80-100	60-100	45-60	25-35
	48-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	95-100	85-95	70-95	35-60	15-30
Uw*:											
Urban land.											
Wymore------------	0-7	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	38-55	15-25
	7-30	Silty clay------	CH	A-7	0	100	100	95-100	95-100	55-65	30-40
	30-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
UxC*:											
Urban land.											
Wymore------------	0-5	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	38-55	15-25
	5-29	Silty clay------	CH	A-7	0	100	100	95-100	95-100	55-65	30-40
	29-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
UxC*:											
Sharpsburg	0-8	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	8-21	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-60	20-35
	21-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
Wb	0-9	Silty clay	CH	A-7	0	100	100	100	95-100	50-75	30-55
Wabash	9-60	Silty clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
Wt, WtB, WtC2, WtD	0-8	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	38-55	15-25
Wymore	8-30	Silty clay	CH	A-7	0	100	100	95-100	95-100	55-65	30-40
	30-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
WtD3	0-6	Silty clay	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	38-55	15-25
Wymore	6-23	Silty clay	CH	A-7	0	100	100	95-100	95-100	55-65	30-40
	23-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
Zc	0-8	Silty clay loam	CL	A-6, A-7, A-4	0	100	100	90-100	70-95	25-45	8-25
Zoe	8-39	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	85-95	35-60	15-35
	39-60	Silty clay	CH	A-7	0	100	100	95-100	90-95	50-70	25-40
Zo	0-20	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Zook	20-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Zp	0-26	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	26-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
BpF*:									
Burchard----------	0-8	0.2-0.6	0.17-0.19	5.6-7.3	<2	Moderate	0.32	5	6
	8-33	0.2-0.6	0.15-0.17	6.6-7.8	<2	Moderate	0.32		
	33-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
Nodaway----------	0-60	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.37	5	7
BrD, BrE---------- Burchard	0-8	0.2-0.6	0.17-0.19	5.6-7.3	<2	Moderate	0.32	4	6
	8-33	0.2-0.6	0.15-0.17	6.6-7.8	<2	Moderate	0.32		
	33-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
Bu, Bw------------ Butler	0-12	0.6-2.0	0.20-0.22	5.6-6.0	<2	Moderate	0.37	4	6
	12-34	0.06-0.2	0.11-0.13	6.6-7.8	<2	High------	0.37		
	34-60	0.2-0.6	0.18-0.20	7.9-8.4	<2	High------	0.37		
Co---------------- Colo	0-12	0.2-0.6	0.21-0.23	5.6-7.3	<2	High------	0.28	5	7
	12-36	0.2-0.6	0.18-0.20	6.1-7.3	<2	High------	0.28		
	36-60	0.2-0.6	0.18-0.20	6.1-7.3	<2	High------	0.28		
Cp*:									
Colo-------------	0-12	0.2-0.6	0.21-0.23	5.6-7.3	<2	High------	0.28	5	7
	12-36	0.2-0.6	0.18-0.20	6.1-7.3	<2	High------	0.28		
	36-60	0.2-0.6	0.18-0.20	6.1-7.3	<2	High------	0.28		
Nodaway----------	0-60	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.37	5	7
Cr---------------- Crete	0-8	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6
	8-31	0.06-0.6	0.12-0.14	6.1-7.3	<2	High------	0.37		
	31-60	0.2-2.0	0.18-0.22	7.4-7.8	<2	High------	0.37		
CrB, CrC---------- Crete	0-11	0.2-0.6	0.21-0.23	5.6-6.0	<2	High------	0.37	4	7
	11-35	0.06-0.6	0.12-0.14	6.1-7.3	<2	High------	0.37		
	35-60	0.2-2.0	0.18-0.22	7.4-7.8	<2	High------	0.37		
CsB--------------- Crete Variant	0-6	0.2-0.6	0.21-0.23	6.6-7.8	2-4	Moderate	0.37	4	7
	6-20	0.06-0.2	0.12-0.14	7.4-9.0	4-8	High------	0.37		
	20-60	0.2-0.6	0.18-0.20	8.5-9.0	2-4	High------	0.37		
Ct---------------- Crete	0-13	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6
	13-31	0.06-0.6	0.12-0.14	6.1-7.3	<2	High------	0.37		
	31-60	0.2-2.0	0.18-0.22	7.4-7.8	<2	High------	0.37		
DcD, DcD2--------- Dickinson	0-12	2.0-6.0	0.12-0.15	5.6-7.3	<2	Low-------	0.20	4	3
	12-30	2.0-6.0	0.12-0.15	5.6-6.5	<2	Low-------	0.20		
	30-60	6.0-20	0.08-0.10	5.6-6.5	<2	Low-------	0.20		
Fm---------------- Fillmore	0-16	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	0.37	4	6
	16-48	<0.06	0.11-0.13	5.6-7.8	<2	High------	0.37		
	48-60	0.2-0.6	0.18-0.20	6.6-7.8	<2	High------	0.37		
GeD, GeD2--------- Geary	0-12	0.6-2.0	0.18-0.24	5.6-6.5	<2	Low-------	0.32	5	6
	12-37	0.2-2.0	0.17-0.20	6.1-7.8	<2	Moderate	0.43		
	37-60	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.43		
HeF--------------- Hedville	0-16	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low-------	0.32	2	3
	16	---	---	---	---	----------	---		
JfC--------------- Judson	0-15	2.0-6.0	0.16-0.18	6.1-7.3	<2	Low-------	0.20	5	3
	15-60	0.6-2.0	0.17-0.19	6.1-7.8	<2	Moderate	0.28		
JuC--------------- Judson	0-29	0.6-2.0	0.21-0.23	6.1-7.3	<2	Moderate	0.28	5	7
	29-60	0.6-2.0	0.21-0.23	6.1-7.8	<2	Moderate	0.43		

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
Ke---------------- Kennebec	0-45	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6
	45-60	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.43		
Lm---------------- Lamo	0-29	0.2-0.6	0.21-0.23	7.4-8.4	<2	High------	0.28	5	7
	29-60	0.2-0.6	0.18-0.20	7.4-8.4	<2	High------	0.28		
McD, McF--------- Malcolm	0-10	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low--------	0.32	5	5
	10-28	0.2-2.0	0.18-0.22	5.6-6.5	<2	Moderate	0.43		
	28-60	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.43		
MeC2, MeD2------- Mayberry	0-12	0.2-0.6	0.17-0.23	5.6-6.0	<2	Moderate	0.37	3	4
	12-48	0.06-0.2	0.10-0.12	5.6-7.3	<2	High------	0.37		
	48-60	0.06-0.2	0.09-0.16	5.6-7.3	<2	Moderate	0.37		
MhC3------------- Mayberry	0-6	0.06-0.2	0.12-0.14	5.6-6.0	<2	High------	0.37	2	4
	6-37	0.06-0.2	0.10-0.12	5.6-7.3	<2	High------	0.37		
	37-60	0.06-0.2	0.09-0.16	5.6-7.3	<2	Moderate	0.37		
MrD, MrD2, MrE--- Morrill	0-8	0.6-2.0	0.14-0.21	5.1-6.5	<2	Low--------	0.28	5	6
	8-32	0.2-0.6	0.15-0.19	5.1-6.5	<2	Moderate	0.28		
	32-60	0.2-2.0	0.15-0.18	5.1-7.3	<2	Low--------	0.37		
No, Ns----------- Nodaway	0-60	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.37	5	7
PaC2, PaD2------- Pawnee	0-7	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	0.37	3	6
	7-38	0.06-0.2	0.09-0.11	6.1-8.4	<2	High------	0.37		
	38-60	0.2-0.6	0.14-0.16	7.9-8.4	<2	High------	0.37		
PbC3------------- Pawnee	0-6	0.06-0.2	0.09-0.11	5.6-6.5	<2	High------	0.37	2	4
	6-30	0.06-0.2	0.09-0.11	6.1-8.4	<2	High------	0.37		
	30-60	0.2-0.6	0.14-0.16	7.9-8.4	<2	High------	0.37		
Pt*. Pits, quarries									
Sa---------------- Salmo	0-18	0.6-2.0	0.19-0.24	6.6-8.4	4-16	Moderate	0.28	5	6
	18-43	0.2-0.6	0.17-0.20	7.4-8.4	4-16	Moderate	0.28		
	43-60	0.2-0.6	0.11-0.20	7.4-8.4	4-16	Moderate	0.28		
Sb, Sc----------- Salmo	0-15	0.2-0.6	0.19-0.24	6.6-8.4	4-16	Moderate	0.28	5	7
	15-24	0.2-0.6	0.17-0.20	7.4-8.4	4-16	Moderate	0.28		
	24-60	0.2-0.6	0.11-0.20	7.4-8.4	4-16	Moderate	0.28		
ShC, ShD, ShD2, ShE2------------ Sharpsburg	0-7	0.6-2.0	0.21-0.23	5.1-6.5	<2	Moderate	0.32	5	7
	7-44	0.2-0.6	0.18-0.20	5.1-6.0	<2	High------	0.43		
	44-60	0.2-0.6	0.18-0.20	6.1-6.5	<2	Moderate	0.43		
Sk---------------- Sharpsburg	0-11	0.6-2.0	0.21-0.23	5.1-6.5	<2	Moderate	0.32	5	7
	11-40	0.2-0.6	0.18-0.20	5.1-6.0	<2	High------	0.43		
	40-60	0.2-0.6	0.18-0.20	6.1-6.5	<2	Moderate	0.43		
SmD-------------- Shelby	0-13	0.6-2.0	0.20-0.22	5.6-6.5	<2	Moderate	0.28	5	6
	13-55	0.2-0.6	0.16-0.18	5.6-7.8	<2	Moderate	0.28		
	55-60	0.2-0.6	0.16-0.18	6.6-8.4	<2	Moderate	0.37		
SoF*: Sogn------------	0-9	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.28	1	4L
	9	---	---	---	---	----------	---		
Rock outcrop.									

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
StD, StF--------- Steinauer	0-5 5-60	0.6-2.0 0.2-2.0	0.18-0.20 0.13-0.16	7.4-8.4 7.9-8.4	<2 <2	Low------- Moderate	0.32 0.32	5	4L
SuD2, SuG-------- Steinauer	0-6 6-60	0.2-0.6 0.2-0.6	0.16-0.17 0.14-0.17	7.4-8.4 7.9-8.4	<2 <2	Moderate Moderate	0.32 0.32	4	4L
Ua*. Udorthents									
Uc*: Urban land.									
Crete-----------	0-8 8-31 31-60	0.6-2.0 0.06-0.6 0.2-2.0	0.22-0.24 0.12-0.14 0.18-0.22	5.6-6.0 6.1-7.3 7.4-7.8	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	6
Sharpsburg------	0-14 14-48 48-60	0.6-2.0 0.2-0.6 0.2-0.6	0.21-0.23 0.18-0.20 0.18-0.20	5.1-6.5 5.1-6.0 6.1-6.5	<2 <2 <2	Moderate High------ Moderate	0.32 0.43 0.43	5	7
UdB*: Urban land.									
Judson-----------	0-28 28-60	0.6-2.0 0.6-2.0	0.21-0.23 0.21-0.23	6.1-7.3 6.1-7.8	<2 <2	Moderate Moderate	0.28 0.43	5	7
Uk*: Urban land.									
Kennebec---------	0-36 36-60	0.6-2.0 0.6-2.0	0.22-0.24 0.20-0.22	5.6-7.3 6.1-7.3	<2 <2	Moderate Moderate	0.32 0.43	5	6
UpC*: Urban land.									
Pawnee-----------	0-10 10-30 30-60	0.2-0.6 0.06-0.2 0.2-0.6	0.17-0.19 0.09-0.11 0.14-0.16	5.6-6.5 6.1-8.4 7.9-8.4	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	3	6
Mayberry---------	0-12 12-48 48-60	0.2-0.6 0.06-0.2 0.06-0.2	0.17-0.23 0.10-0.12 0.09-0.16	5.6-6.0 5.6-7.3 5.6-7.3	<2 <2 <2	Moderate High------ Moderate	0.37 0.37 0.37	3	4
Uw*: Urban land.									
Wymore-----------	0-7 7-30 30-60	0.2-0.6 0.06-0.2 0.2-0.6	0.21-0.23 0.11-0.14 0.18-0.20	5.6-6.5 5.6-7.3 6.6-7.3	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	6
UxC*: Urban land.									
Wymore-----------	0-5 5-29 29-60	0.2-0.6 0.06-0.2 0.2-0.6	0.21-0.23 0.11-0.14 0.18-0.20	5.6-6.5 5.6-7.3 6.6-7.3	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	6
Sharpsburg------	0-8 8-21 21-60	0.6-2.0 0.2-0.6 0.2-0.6	0.21-0.23 0.18-0.20 0.18-0.20	5.1-6.5 5.1-6.0 6.1-6.5	<2 <2 <2	Moderate High------ Moderate	0.32 0.43 0.43	5	7

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
Wb----------------	0-9	<0.06	0.12-0.14	5.6-7.3	<2	High------	0.28	5	4
Wabash	9-60	<0.06	0.08-0.12	5.6-7.8	<2	High------	0.28		
Wt, WtB, WtC2, WtD-------------	0-8	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	6
Wymore	8-30	0.06-0.2	0.11-0.14	5.6-7.3	<2	High------	0.37		
	30-60	0.2-0.6	0.18-0.20	6.6-7.3	<2	High------	0.37		
WtD3-------------	0-6	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	6
Wymore	6-23	0.06-0.2	0.11-0.14	5.6-7.3	<2	High------	0.37		
	23-60	0.2-0.6	0.18-0.20	6.6-7.3	<2	High------	0.37		
Zc----------------	0-8	0.2-0.6	0.17-0.23	6.1-7.8	<4	Moderate	0.32	5	4
Zoe	8-39	0.06-0.6	0.11-0.20	6.1-7.8	4-8	High------	0.32		
	39-60	0.06-0.2	0.10-0.13	7.4-9.0	2-4	High------	0.32		
Zo----------------	0-20	0.6-2.0	0.22-0.24	5.6-7.8	<2	Moderate	0.28	5	6
Zook	20-60	0.06-0.2	0.11-0.13	5.6-7.8	<2	High------	0.28		
Zp----------------	0-20	0.2-0.6	0.21-0.23	5.6-7.8	<2	High------	0.28	5	7
Zook	20-60	0.06-0.2	0.11-0.13	5.6-7.8	<2	High------	0.28		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
BpF*:												
Burchard	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Nodaway	B	Frequent	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High	Moderate	Low.
BrD, BrE Burchard	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Bu, Bw Butler	D	Occasional	Brief	Mar-Jul	1.0-3.0	Perched	Mar-Jul	>60	---	High	High	Low.
Co Colo	B/D	Occasional	Very brief to long.	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Cp*:												
Colo	B/D	Frequent	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Nodaway	B	Frequent	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High	Moderate	Low.
Cr, CrB, CrC Crete	D	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
CsB Crete Variant	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	High.
Ct Crete	D	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
DcD, DcD2 Dickinson	A	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
Fm Fillmore	D	Occasional	Long	Apr-Jul	+.5-1.0	Perched	Mar-Jul	>60	---	High	High	Low.
GeD, GeD2 Geary	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
HeF Hedville	D	None	---	---	>6.0	---	---	4-20	Hard	Moderate	Low	Moderate.
JfC Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
JuC Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ke------------------ Kennebec	B	Occasional	Brief-----	Feb-Nov	4.0-6.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
Lm------------------ Lamo	C	Occasional	Brief-----	Mar-Aug	2.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
McD, McF----------- Malcolm	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
MeC2, MeD2, MhC3-- Mayberry	D	None---------	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High-----	High-----	Low.
MrD, MrD2, MrE---- Morrill	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
No, Ns------------- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	>6.0	---	---	>60	---	High-----	Moderate	Low.
PaC2, PaD2, PbC3-- Pawnee	D	None---------	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High-----	High-----	Low.
Pt*. Pits, quarries												
Sa------------------ Salmo	C/D	Occasional	Brief-----	Mar-Oct	2.0-3.0	Apparent	Sep-Jun	>60	---	High-----	High-----	High.
Sb------------------ Salmo	C/D	Frequent----	Brief-----	Mar-Oct	0-2.5	Apparent	Sep-Jun	>60	---	High-----	High-----	High.
Sc------------------ Salmo	C/D	Occasional	Brief-----	Mar-Oct	0-2.5	Apparent	Sep-Jun	>60	---	High-----	High-----	High.
ShC, ShD, ShD2, ShE2, Sk--------- Sharpsburg	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
SmD---------------- Shelby	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
SoF*:												
Sogn--------------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Moderate	Low------	Low.
Rock outcrop.												
StD, StF, SuD2, SuG--------------- Steinauer	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Ua*. Udorthents												
Uc*: Urban land.												

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Uc*:												
Crete	D	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Sharpsburg	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
UdB*:												
Urban land.												
Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Uk*:												
Urban land.												
Kennebec	B	Occasional	Brief	Feb-Nov	4.0-6.0	Apparent	Nov-Jul	>60	---	High	Moderate	Low.
UpC*:												
Urban land.												
Pawnee	D	None	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High	High	Low.
Mayberry	D	None	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High	High	Low.
Uw*:												
Urban land.												
Wymore	D	None	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High	High	Moderate.
UxC*:												
Urban land.												
Wymore	D	None	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High	High	Moderate.
Sharpsburg	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
Wb Wabash	D	Occasional	Brief to long.	Nov-May	0-1.0	Perched	Nov-May	>60	---	Moderate	High	Moderate.
Wt, WtB, WtC2, WtD, WtD3 Wymore	D	None	---	---	1.0-3.0	Perched	Mar-Jun	>60	---	High	High	Moderate.
Zc Zoe	D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High	High	High.
Zo, Zp Zook	C/D	Occasional	Brief to long.	Feb-Nov	2.0-4.0	Apparent	Nov-May	>60	---	High	High	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate that data were not available]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve						Percentage smaller than--						
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture
												Pct		Lb/ft3	Pct
Burchard clay loam: (S76NE-109-013)															
Ap------ 0 to 8	A-6 (10)	CL	100	100	100	99	94	71	48	36	30	37	16	--	--
B22t---- 11 to 22	A-7-6(15)	CL	100	100	100	99	92	72	55	41	36	48	26	--	--
C------- 33 to 60	A-7-6(15)	CL	100	100	100	98	92	72	55	40	32	45	27	--	--
Butler silt loam: (S76NE-109-023)															
Ap------ 0 to 6	A-6 (08)	CL	100	100	100	100	100	99	63	32	24	35	11	--	--
B21t---- 12 to 25	A-7-6(27)	CH	100	100	100	100	100	99	80	60	53	69	42	--	--
C------- 43 to 60	A-7-6(17)	CL-CH	100	100	100	100	99	99	66	41	34	50	28	--	--
Crete silt loam: (S76NE-109-007)															
Ap------ 0 to 7	A-4 (08)	ML	100	100	100	100	100	99	51	28	24	34	10	--	--
B21t---- 17 to 24	A-7-6(24)	CH	100	100	100	100	100	99	97	54	50	63	38	--	--
C------- 47 to 60	A-7-6(16)	CL	100	100	100	100	100	100	68	40	33	48	25	--	--
Judson silt loam: (S75NE-109-022)															
Ap------ 0 to 6	A-6 (10)	CL	100	100	100	100	99	96	58	36	30	38	14	--	--
B2------ 29 to 42	A-7-6(14)	CL	100	100	100	100	100	98	64	37	33	44	22	--	--
C------- 55 to 60	A-7-6(14)	CL	100	100	100	100	99	95	62	37	33	44	24	--	--
Kennebec silt loam: (S76NE-109-003)															
Ap------ 0 to 10	A-6 (10)	CL	100	100	100	100	100	96	60	33	26	38	15	--	--
A13----- 19 to 45	A-6 (11)	CL	100	100	100	100	100	97	60	33	27	39	17	--	--
A14----- 45 to 56	A-6 (10)	CL	100	100	100	100	100	98	60	31	26	38	16	--	--
Pawnee clay loam: (S76NE-109-022)															
Ap------ 0 to 1	A-7-6(15)	CL	100	99	98	97	93	79	56	40	35	46	25	--	--
B21t---- 13 to 27	A-7-6(23)	CH	100	100	99	99	96	85	66	46	42	59	38	--	--
C------- 38 to 60	A-7-6(16)	CL	100	99	99	98	92	73	57	40	33	45	28	--	--
Sharpsburg silty clay loam: (S76NE-109-015)															
Ap------ 0 to 1	A-7-6(12)	CL	100	100	100	100	100	99	60	40	34	42	18	--	--
B21t---- 12 to 34	A-7-6(18)	CH	100	100	100	100	100	99	73	50	43	53	28	--	--
C------- 44 to 60	A-7-6(15)	CL	100	100	100	100	100	100	68	39	34	46	25	--	--
Steinauer clay loam: (S76NE-109-026)															
A1------ 0 to 6	A-7-6(08)	CL	100	97	96	94	87	61	40	24	18	41	16	--	--
C1------ 12 to 25	A-6 (07)	CL	100	100	100	100	97	68	44	25	18	31	12	--	--
C2------ 25 to 60	A-7-6(15)	CL	100	100	99	97	90	73	57	39	32	45	26	--	--

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve						Percentage smaller than--						
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture
												Pct		Lb/ft3	Pct
Wymore silty clay: (S76NE-109-036)															
Ap------ 0 to 1	A-7-6(15)	CL	100	100	100	100	100	99	69	46	41	48	24	--	--
B21----- 11 to 24	A-7-6(24)	CH	100	100	100	100	100	99	77	52	45	62	38	--	--
C------- 38 to 60	A-7-6(13)	CL	100	100	100	100	100	99	68	37	30	43	22	--	--

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Burchard	Fine-loamy, mixed, mesic Typic Argiudolls
Butler	Fine, montmorillonitic, mesic Abruptic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Crete Variant	Fine, montmorillonitic, mesic Typic Natrustolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Hedville	Loamy, mixed, mesic Lithic Haplustolls
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Lamo	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Malcolm	Coarse-silty, mixed, mesic Typic Argiudolls
Mayberry	Fine, montmorillonitic, mesic Aquic Argiudolls
Morrill	Fine-loamy, mixed, mesic Typic Argiudolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Pawnee	Fine, montmorillonitic, mesic Aquic Argiudolls
Salmo	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Sogn	Loamy, mixed, mesic Lithic Haplustolls
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Wymore	Fine, montmorillonitic, mesic Aquic Argiudolls
Zoe	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

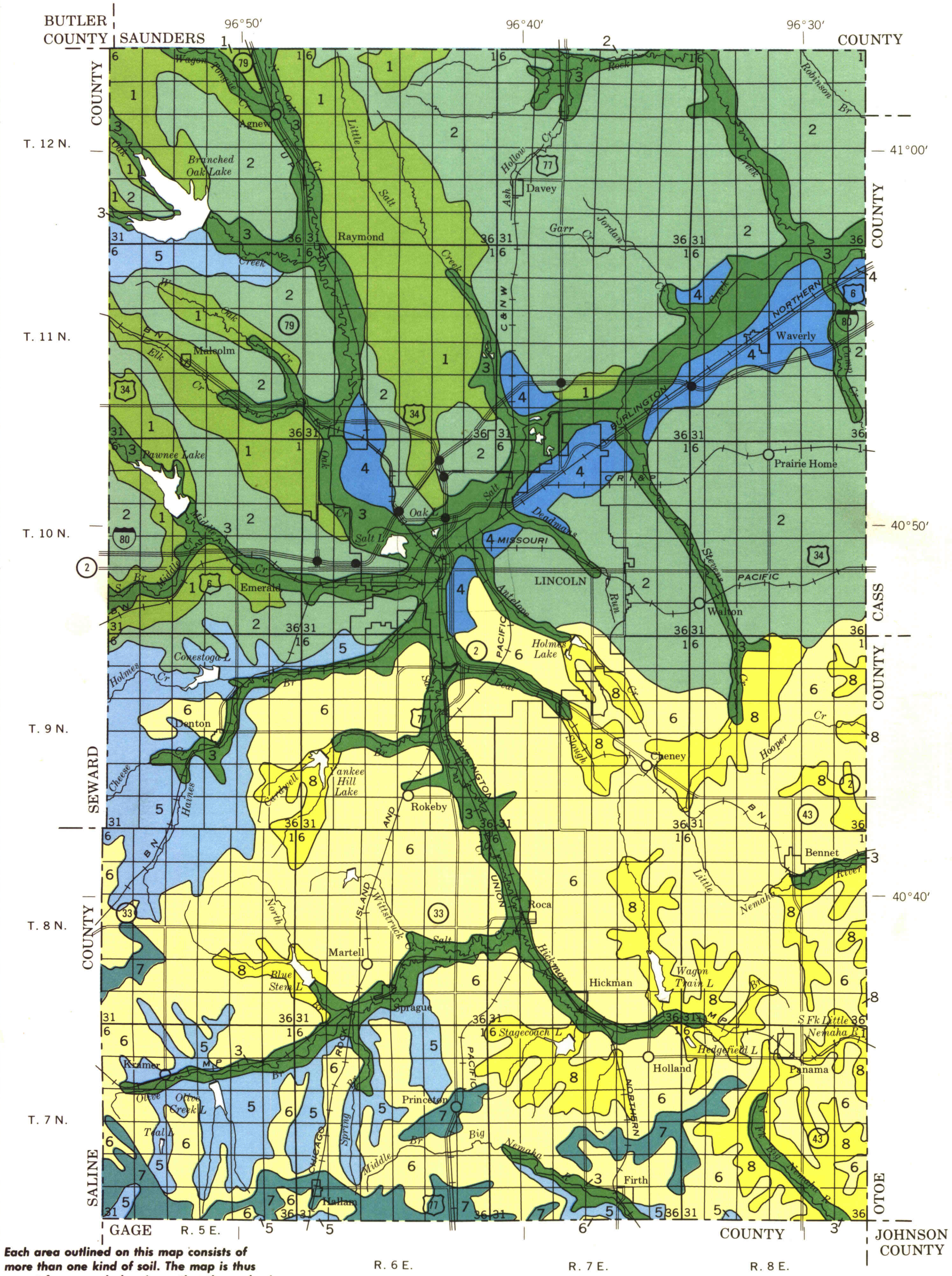
LANCASTER COUNTY, NEBRASKA

Scale 1: 253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N



SOIL LEGEND

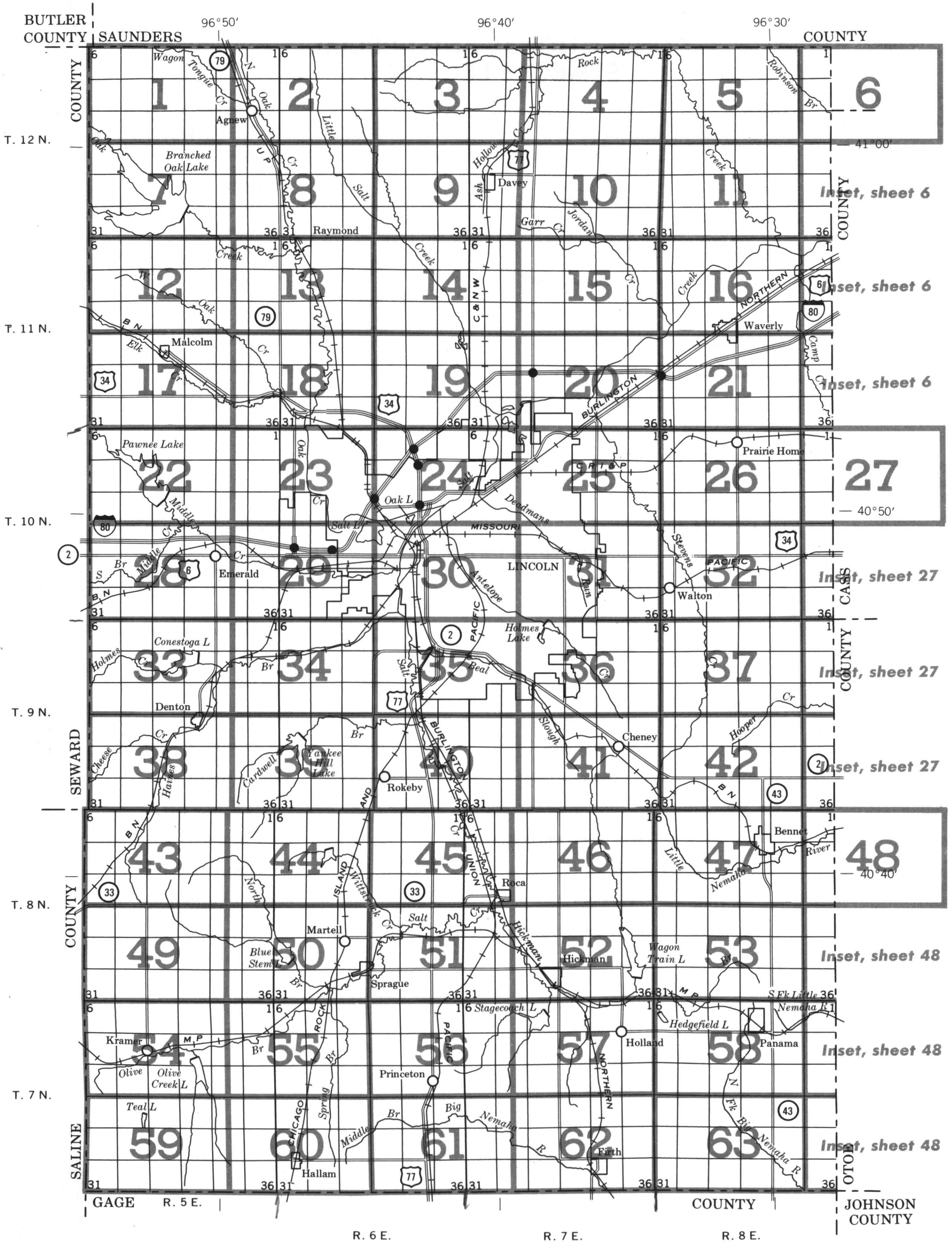
1	Sharpsburg–Pawnee–Burchard association: Deep, gently sloping to steep, moderately well drained and well drained, silty soils that formed in loess and loamy soils that formed in glacial till; on uplands
2	Sharpsburg–Judson association: Deep, nearly level to moderately steep, moderately well drained, silty soils that formed in loess and colluvium; on uplands and foot slopes
3	Kennebec–Nodaway–Zook association: Deep, nearly level and very gently sloping, moderately well drained to poorly drained, silty soils that formed in alluvium; on flood plains
4	Crete–Sharpsburg association: Deep, nearly level to gently sloping, moderately well drained, silty soils that formed in loess; on stream terraces
5	Steinauer–Pawnee–Burchard association: Deep, gently sloping to very steep, well drained and moderately well drained, loamy and clayey soils that formed in glacial till; on uplands
6	Wymore–Pawnee association: Deep, nearly level to strongly sloping, moderately well drained, silty soils that formed in loess and loamy soils that formed in glacial till; on uplands
7	Crete–Wymore–Butler association: Deep, nearly level and very gently sloping, moderately well drained and somewhat poorly drained, silty soils that formed in loess; on uplands
8	Pawnee–Burchard association: Deep, gently sloping to steep, moderately well drained and well drained, loamy and clayey soils that formed in glacial till; on uplands

Compiled 1979

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

LANCASTER COUNTY, NEBRASKA

Scale 1: 253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first two alphabetical symbols represent the soil. The second capital letter indicates slope groups. Symbols without a slope letter indicate that the soil is level or nearly level or are for miscellaneous areas. A final number of 2 indicates that the soil is eroded; number 3 indicates severely eroded.

SYMBOL	NAME	SYMBOL	NAME
BpF	Burchard–Nodaway complex, 2 to 30 percent slopes	PaD2	Pawnee clay loam, 7 to 11 percent slopes, eroded
BrD	Burchard clay loam, 6 to 11 percent slopes	PbC3	Pawnee clay, 2 to 7 percent slopes, severely eroded
BrE	Burchard clay loam, 11 to 15 percent slopes	Pt	Pits, quarries
Bu	Butler silt loam, 0 to 1 percent slopes	Sa	Salmo silt loam, 0 to 2 percent slopes
Bw	Butler silt loam, terrace, 0 to 1 percent slopes	Sb	Salmo silty clay loam, channeled, 0 to 2 percent slopes
Co	Colo silty clay loam, 0 to 2 percent slopes	Sc	Salmo silty clay loam, 0 to 2 percent slopes
Cp	Colo–Nodaway silty clay loams, 0 to 2 percent slopes	ShC	Sharpsburg silty clay loam, 2 to 5 percent slopes
Cr	Crete silt loam, terrace, 0 to 1 percent slopes	ShD	Sharpsburg silty clay loam, 5 to 9 percent slopes
CrB	Crete silty clay loam, terrace, 1 to 3 percent slopes	ShD2	Sharpsburg silty clay loam, 5 to 9 percent slopes, eroded
CrC	Crete silty clay loam, terrace, 3 to 6 percent slopes	ShE2	Sharpsburg silty clay loam, 9 to 15 percent slopes, eroded
CsB	Crete Variant silty clay loam, 1 to 4 percent slopes	Sk	Sharpsburg silty clay loam, terrace, 0 to 2 percent slopes
Ct	Crete silt loam, 0 to 2 percent slopes	SmD	Shelby clay loam, 6 to 11 percent slopes
DcD	Dickinson fine sandy loam, 6 to 11 percent slopes	SoF	Sogn–Rock outcrop complex, 11 to 30 percent slopes
DcD2	Dickinson fine sandy loam, 6 to 11 percent slopes, eroded	StD	Steinauer loam, 6 to 11 percent slopes
Fm	Fillmore silt loam, 0 to 1 percent slopes	StF	Steinauer loam, 11 to 30 percent slopes
GeD	Geary silty clay loam, 6 to 11 percent slopes	SuD2	Steinauer clay loam, 6 to 11 percent slopes, eroded
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded	SuG	Steinauer clay loam, 20 to 40 percent slopes
HeF	Hedville sandy loam, 6 to 30 percent slopes	Ua	Udorthents
JfC	Judson fine sandy loam, 2 to 6 percent slopes	Uc	Urban land–Crete–Sharpsburg complex, 0 to 2 percent slopes
JuC	Judson silt loam, 2 to 6 percent slopes	UdB	Urban land–Judson complex, 1 to 3 percent slopes
Ke	Kennebec silt loam, 0 to 2 percent slopes	Uk	Urban land–Kennebec complex, 0 to 2 percent slopes
Lm	Lamo silty clay loam, 0 to 2 percent slopes	UpC	Urban land–Pawnee–Mayberry complex, 2 to 7 percent slopes
McD	Malcolm silt loam, 6 to 11 percent slopes	Uw	Urban land–Wymore complex, 0 to 2 percent slopes
McF	Malcolm silt loam, 11 to 25 percent slopes	UxC	Urban land–Wymore–Sharpsburg complex, 2 to 7 percent slopes
MeC2	Mayberry silty clay loam, 2 to 7 percent slopes, eroded	Wb	Wabash silty clay, 0 to 1 percent slopes
MeD2	Mayberry silty clay loam, 7 to 11 percent slopes, eroded	Wt	Wymore silty clay loam, 0 to 1 percent slopes
MhC3	Mayberry clay, 2 to 7 percent slopes, severely eroded	WtB	Wymore silty clay loam, 1 to 3 percent slopes
MrD	Morrill clay loam, 6 to 11 percent slopes	WtC2	Wymore silty clay loam, 3 to 7 percent slopes, eroded
MrD2	Morrill clay loam, 6 to 11 percent slopes, eroded	WtD	Wymore silty clay loam, 7 to 11 percent slopes
MrE	Morrill clay loam, 11 to 15 percent slopes	WtD3	Wymore silty clay, 5 to 9 percent slopes, severely eroded
No	Nodaway silt loam, 0 to 2 percent slopes	Zc	Zoe silty clay loam, 0 to 2 percent slopes
Ns	Nodaway silt loam, channeled	Zo	Zook silt loam, 0 to 2 percent slopes
PaC2	Pawnee clay loam, 2 to 7 percent slopes, eroded	Zp	Zook silty clay loam, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CeA; FoB2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

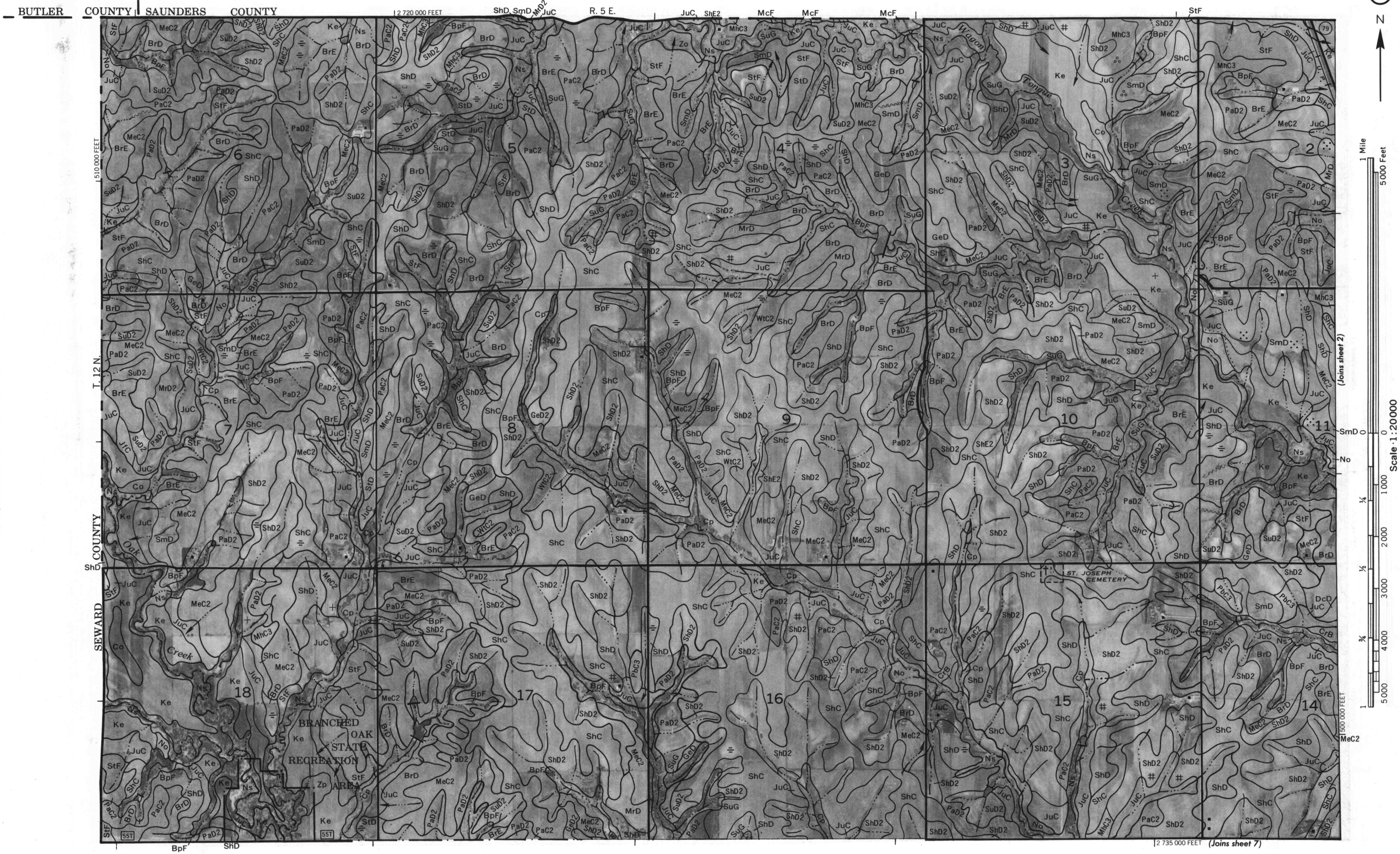
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Cut and fill land spot
- Glacial till spot
- Grayish silt and fine sand spot
- Reddish brown loess spot

LANCASTER COUNTY, NEBRASKA — SHEET NUMBER 1



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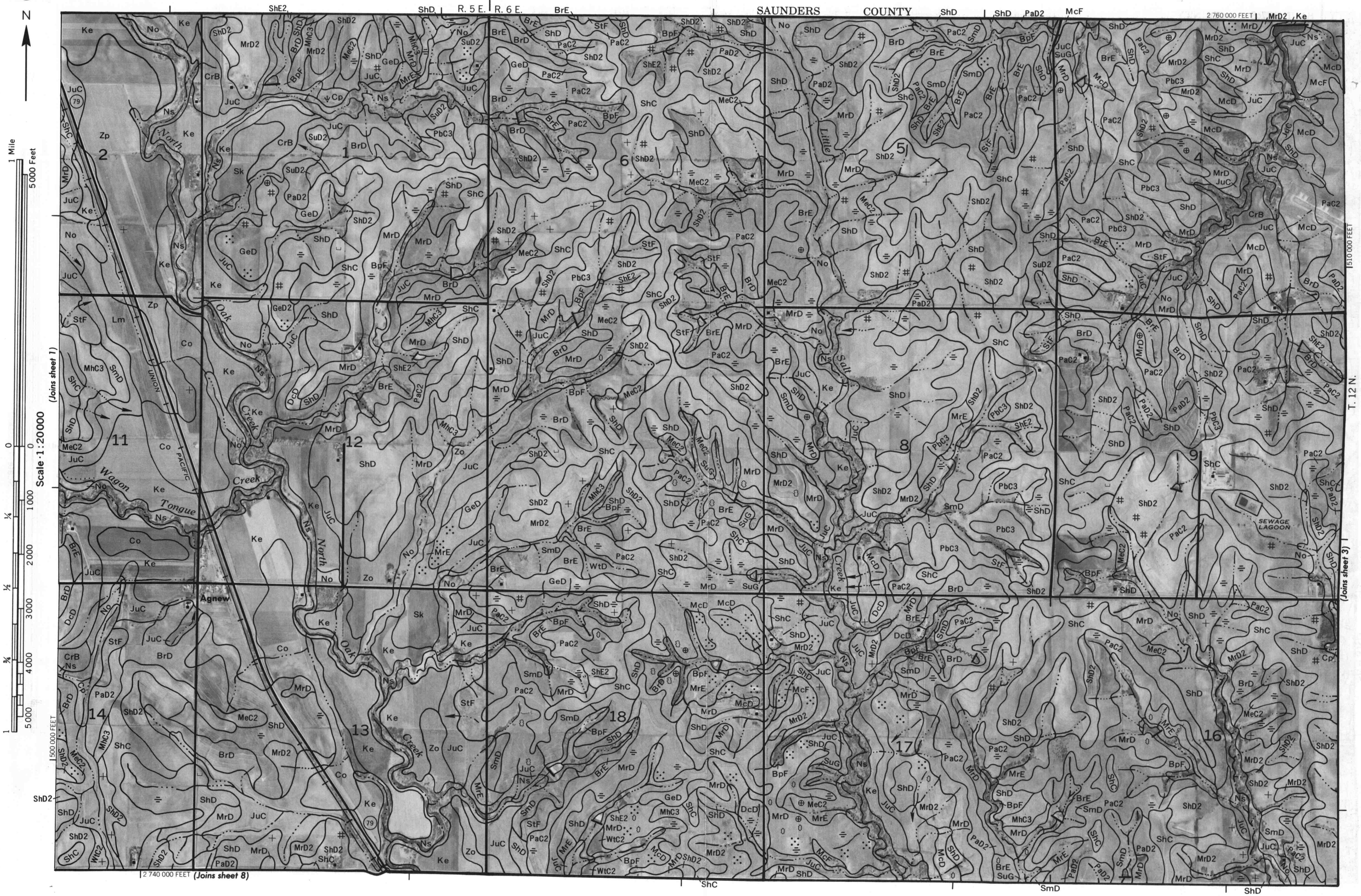
LANCASTER COUNTY, NEBRASKA — SHEET NUMBER 2



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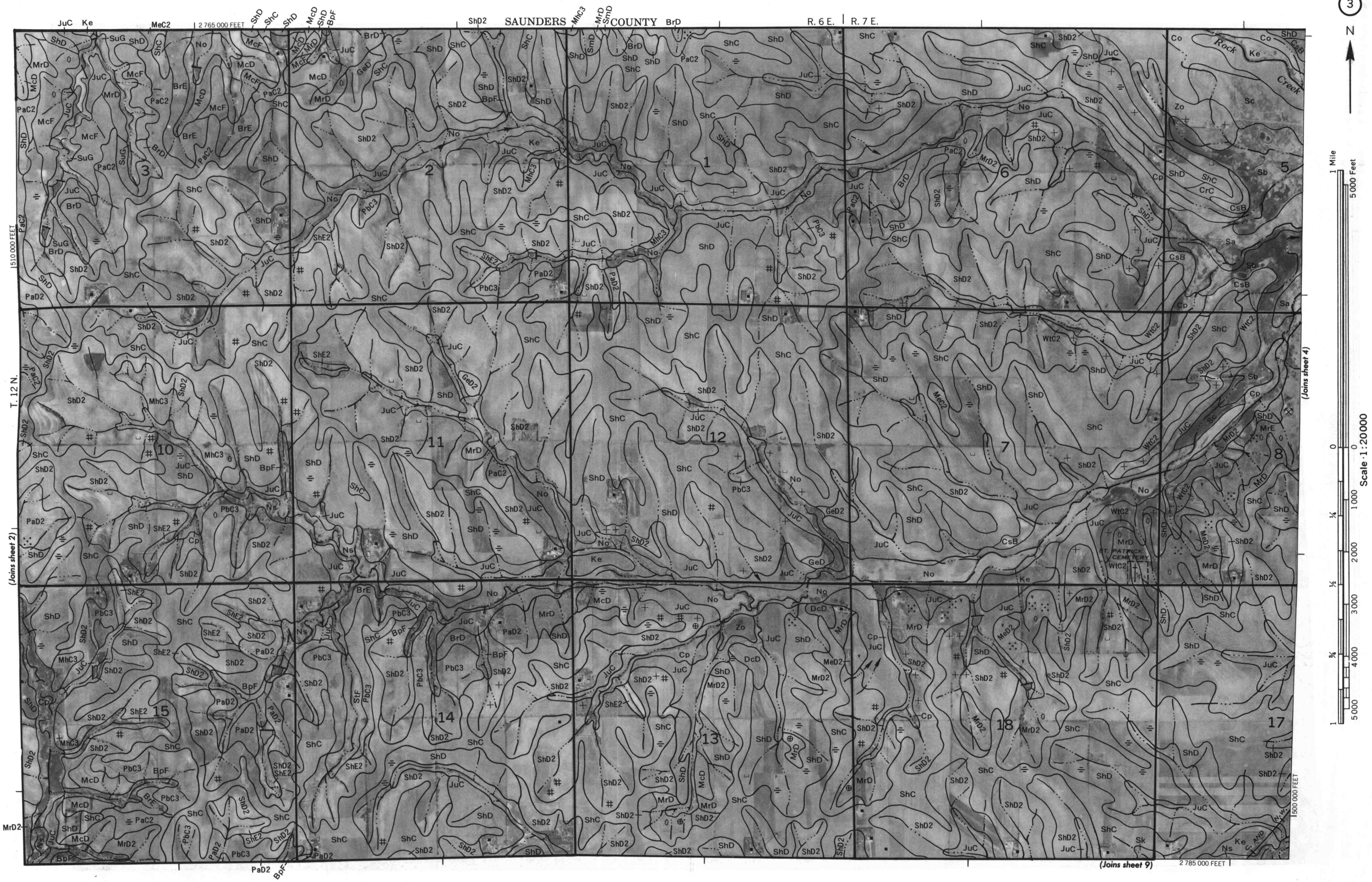

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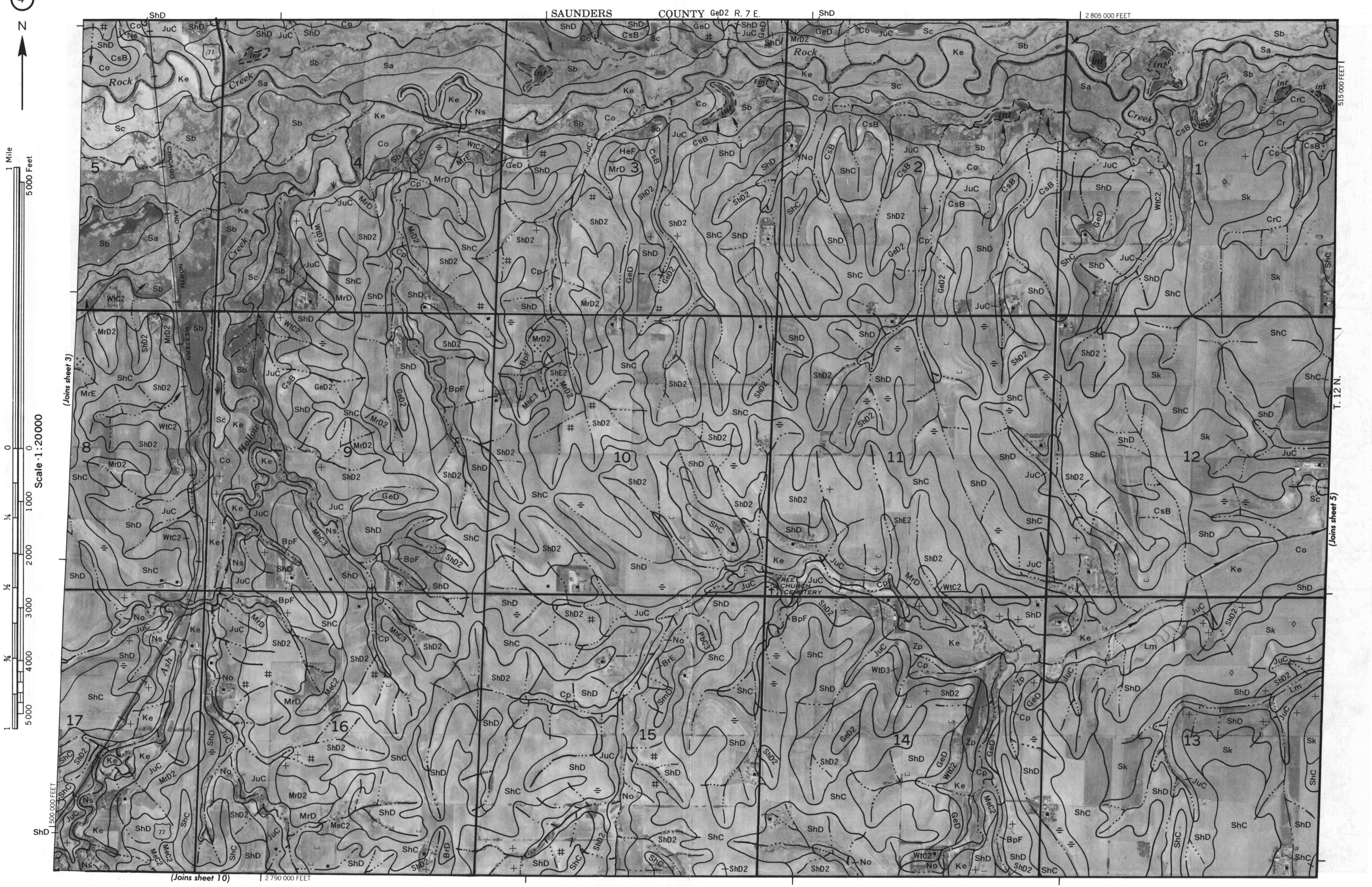

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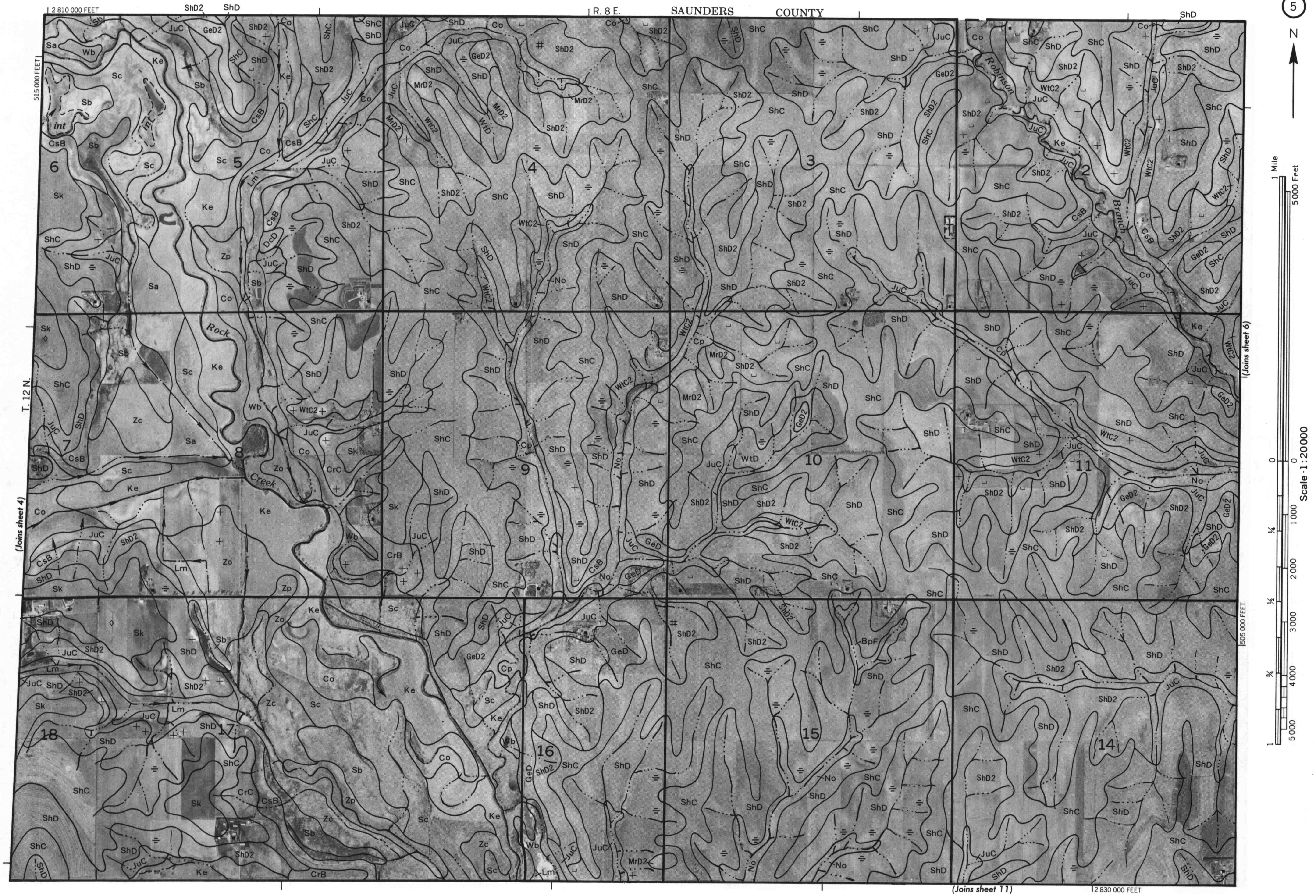
LANCASTER COUNTY, NEBRASKA NO. 4

LANCASTER COUNTY, NEBRASKA — SHEET NUMBER 5



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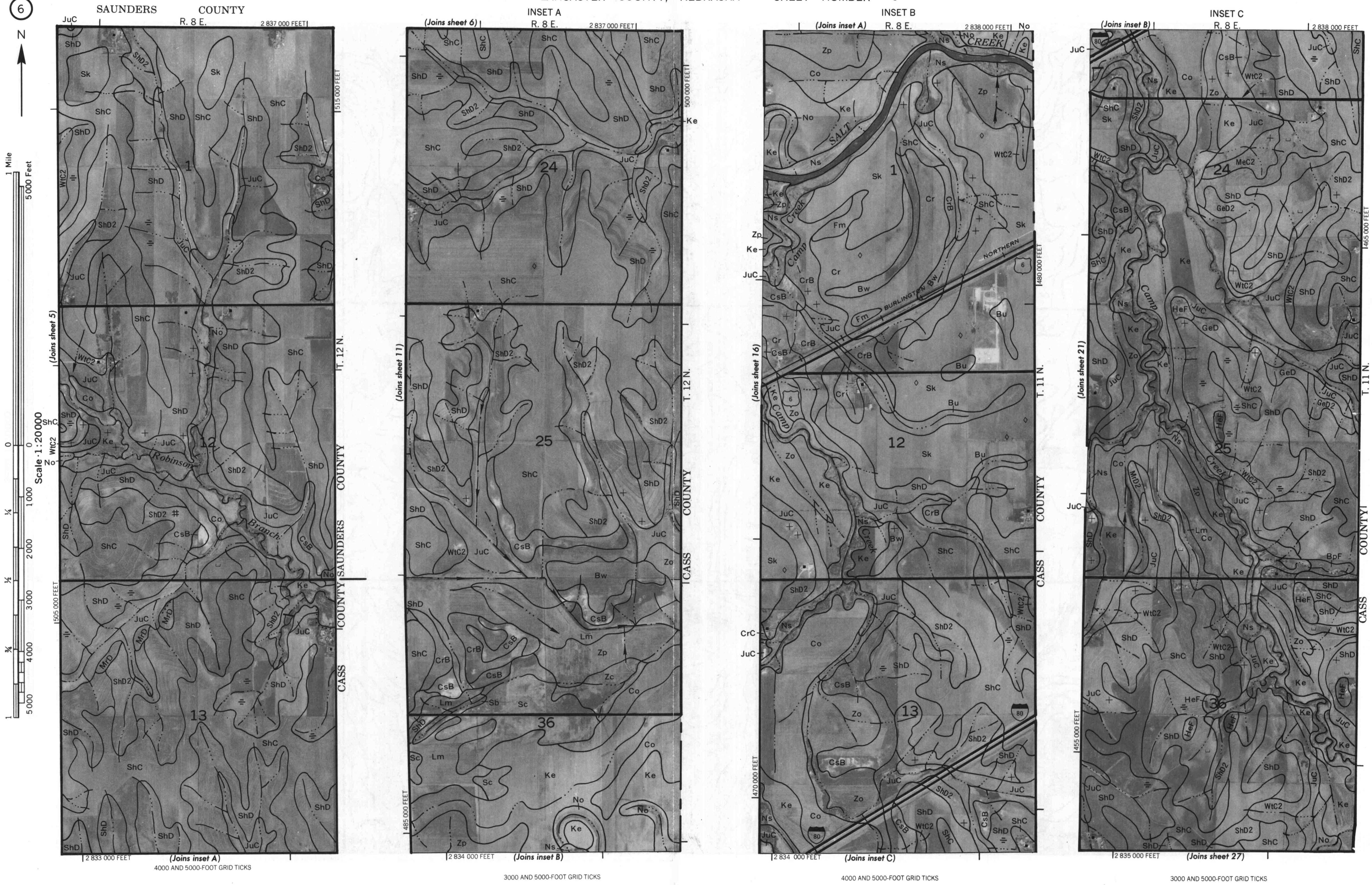

4000 AND 5000-FOOT GRID TICKS

3000 AND 5000-FOOT GRID TICKS

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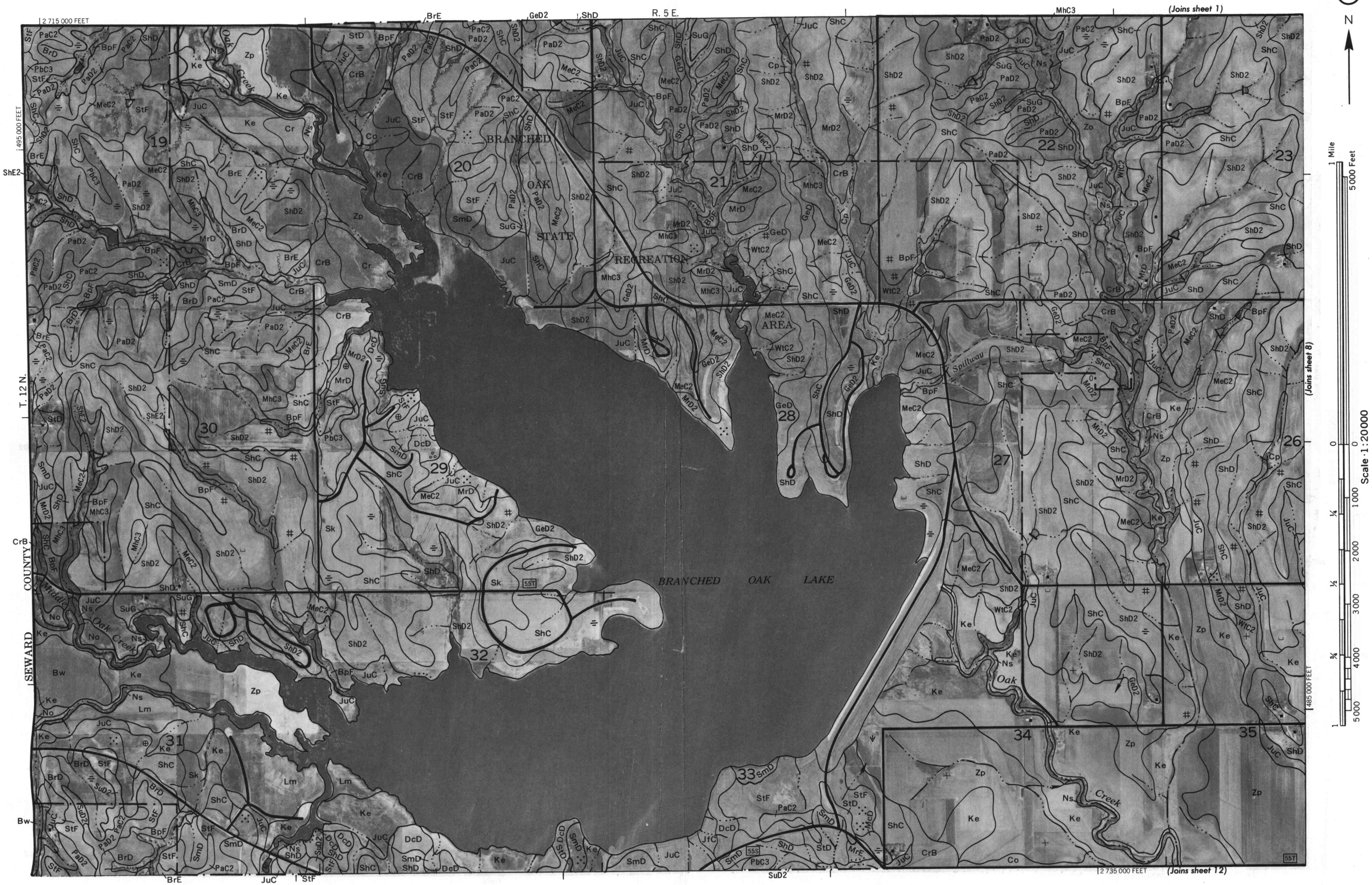

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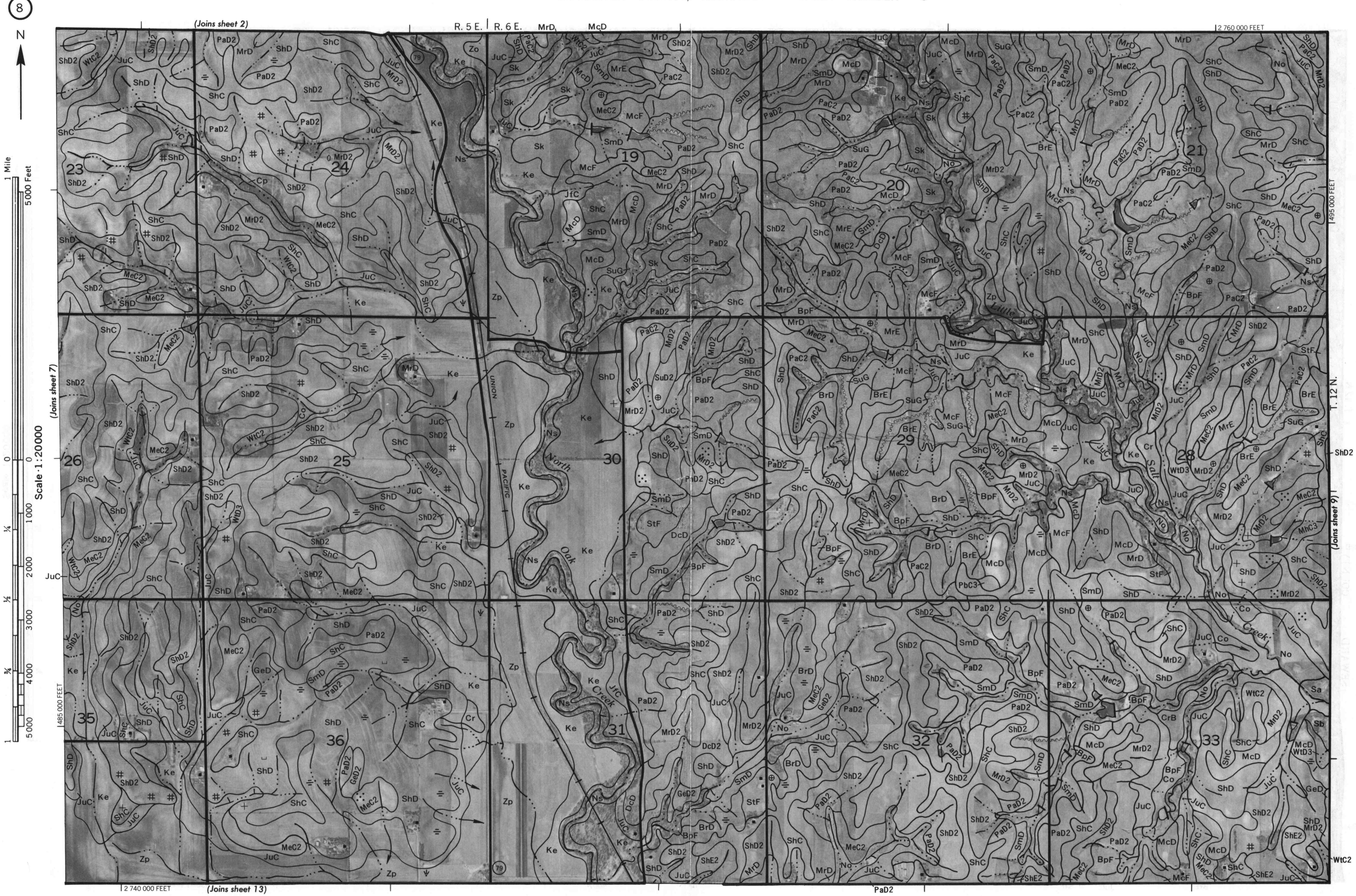

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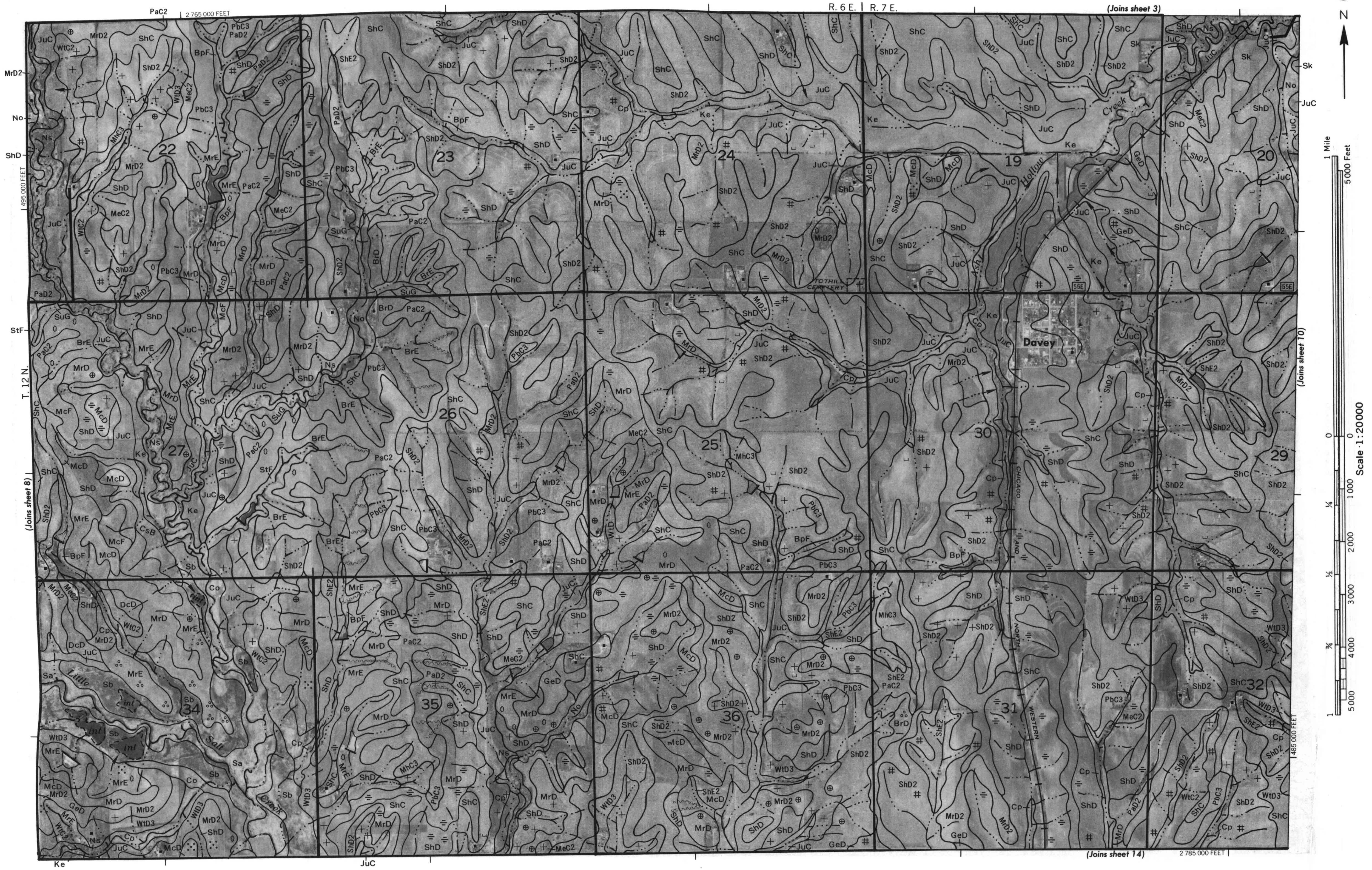
LANCASTER COUNTY, NEBRASKA — SHEET NUMBER 9



LANCASTER COUNTY, NEBRASKA NO. 9

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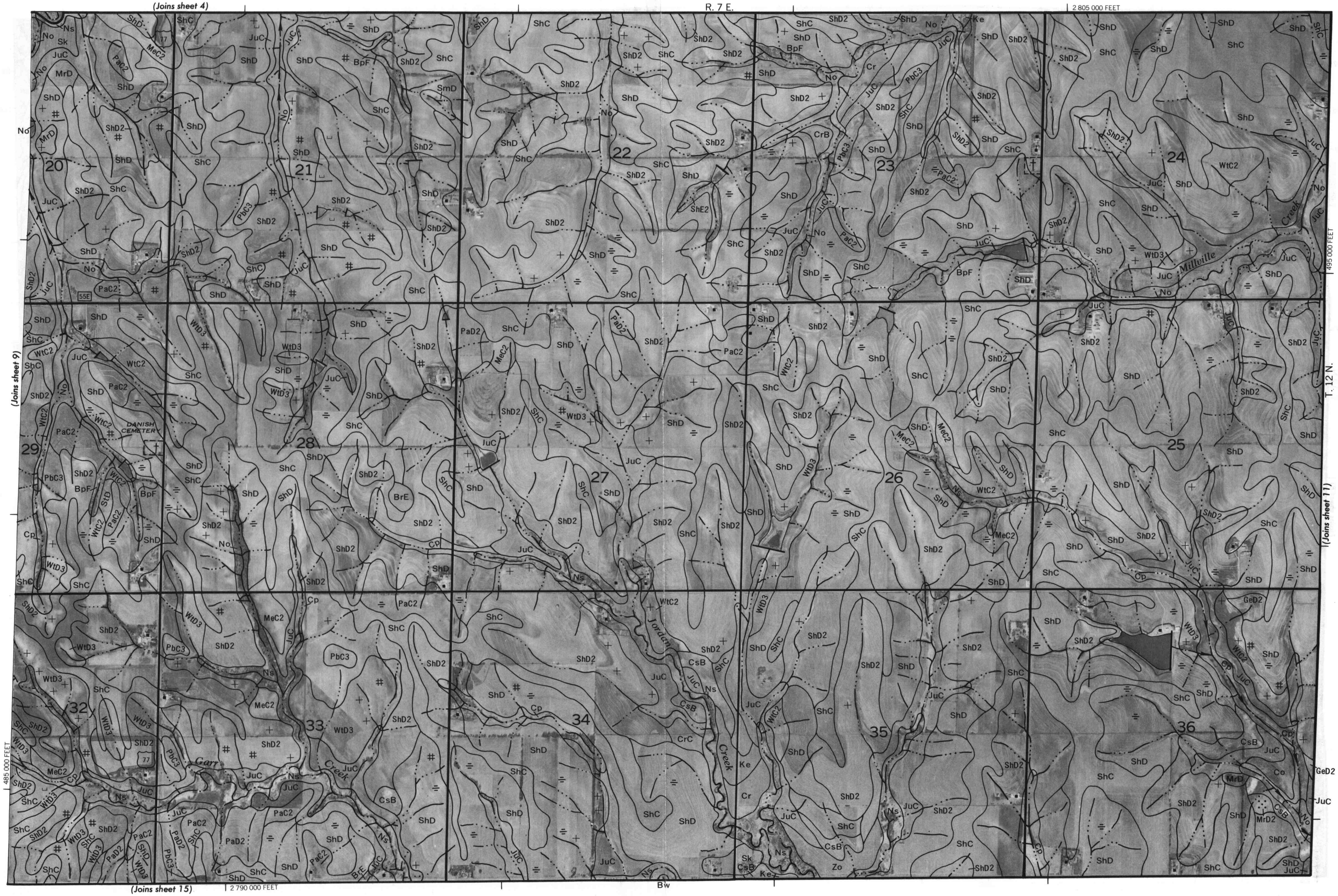
10

N

1 Mile

5000 Feet

Scale 1:20000



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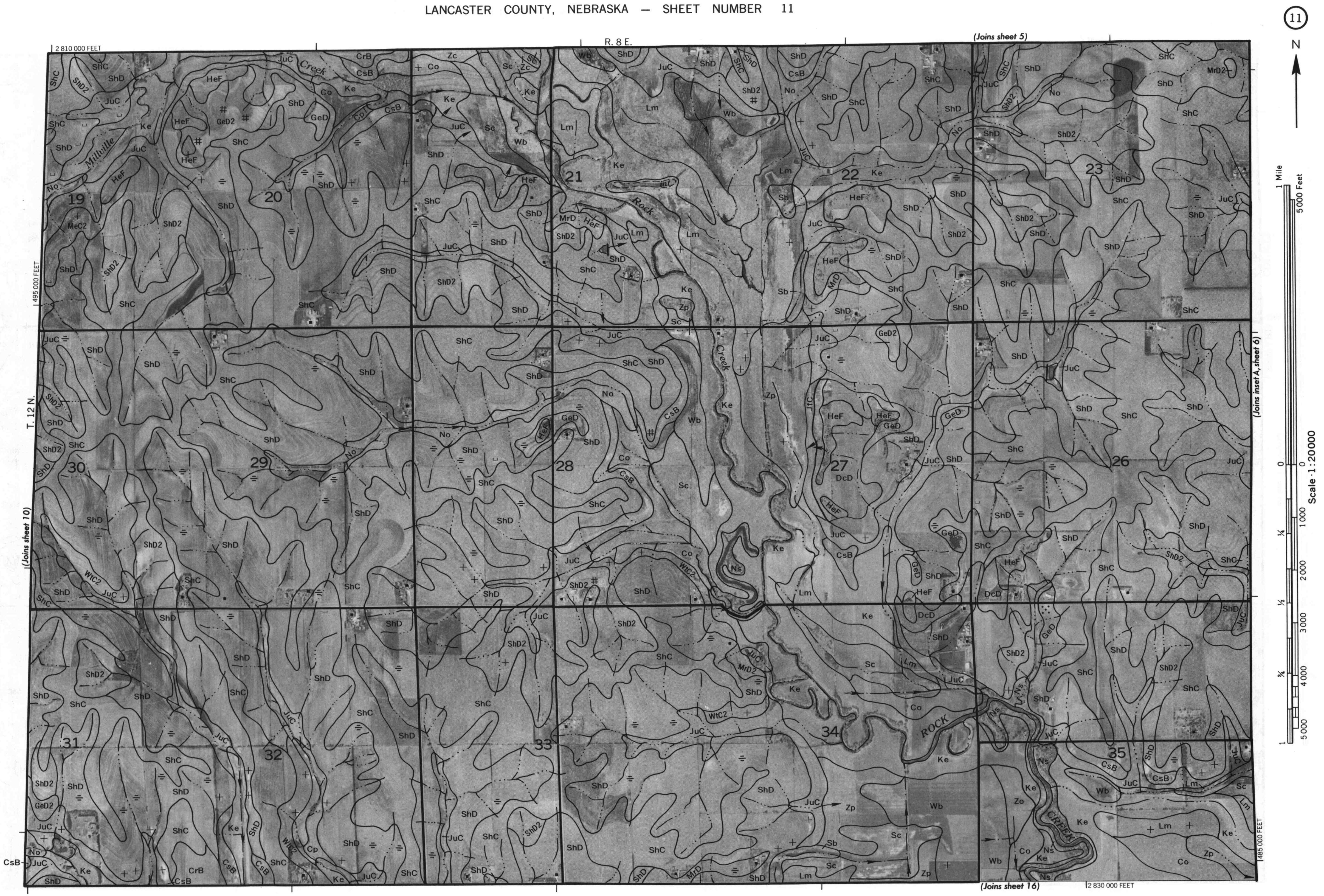

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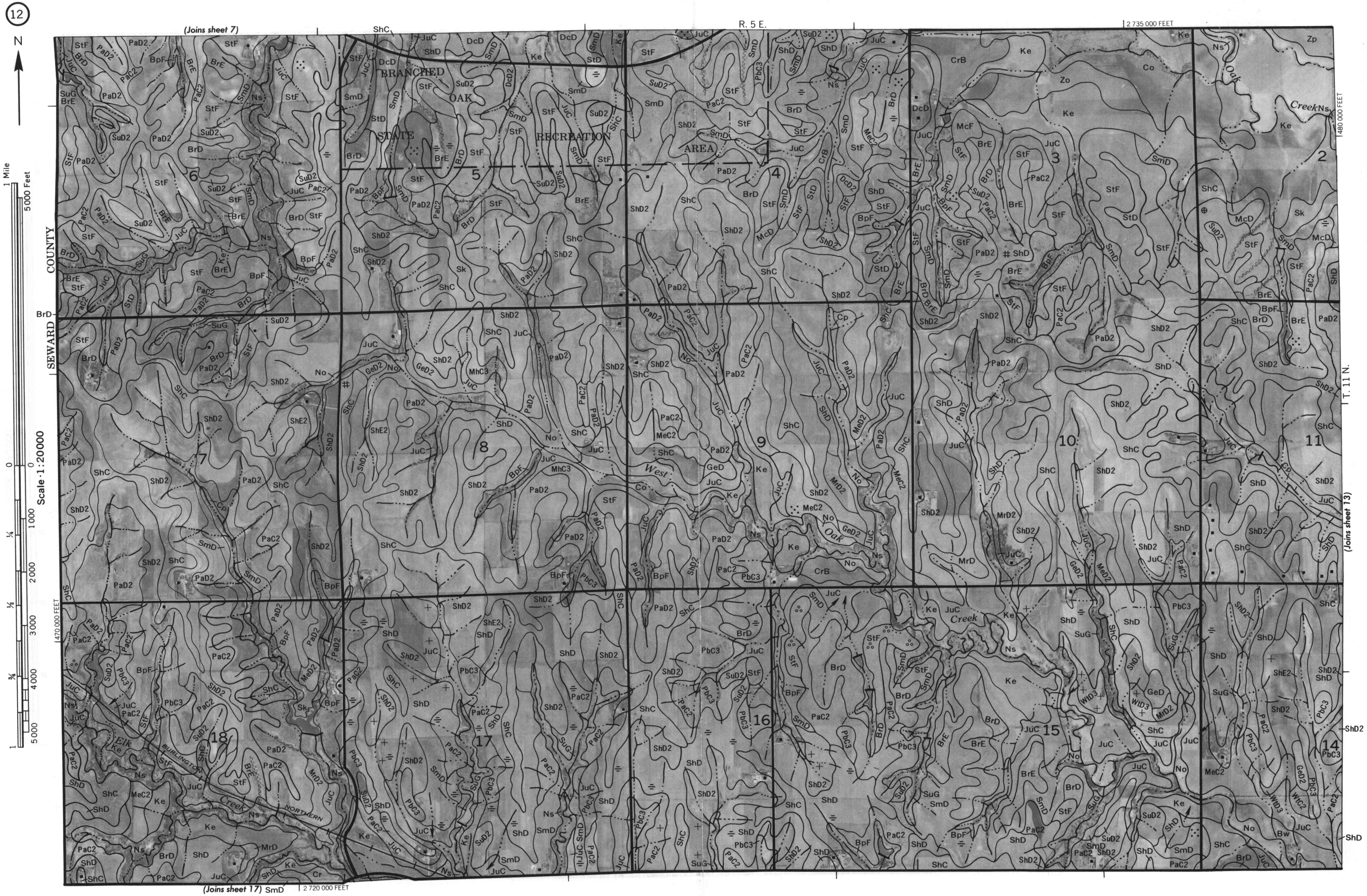

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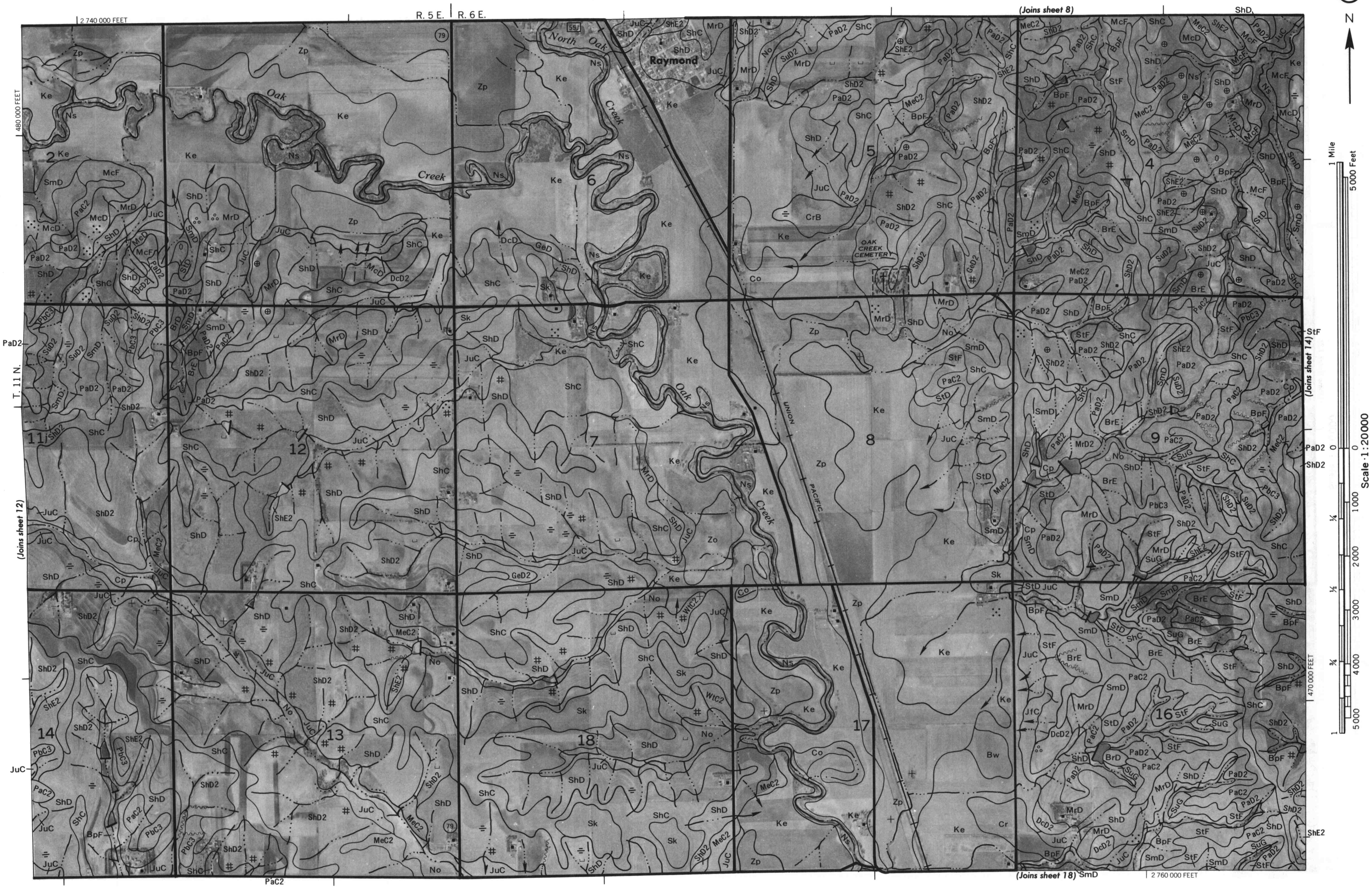

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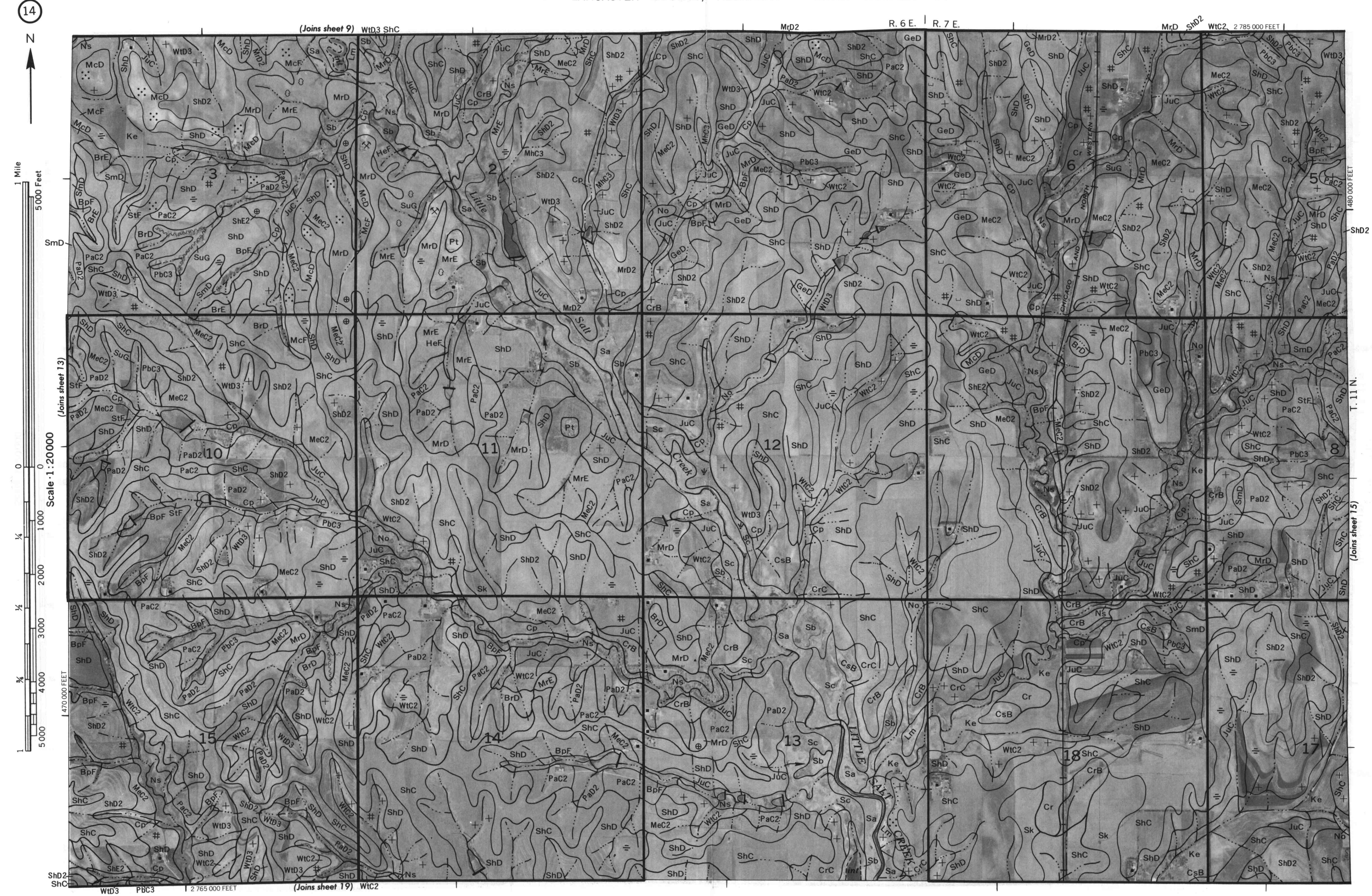

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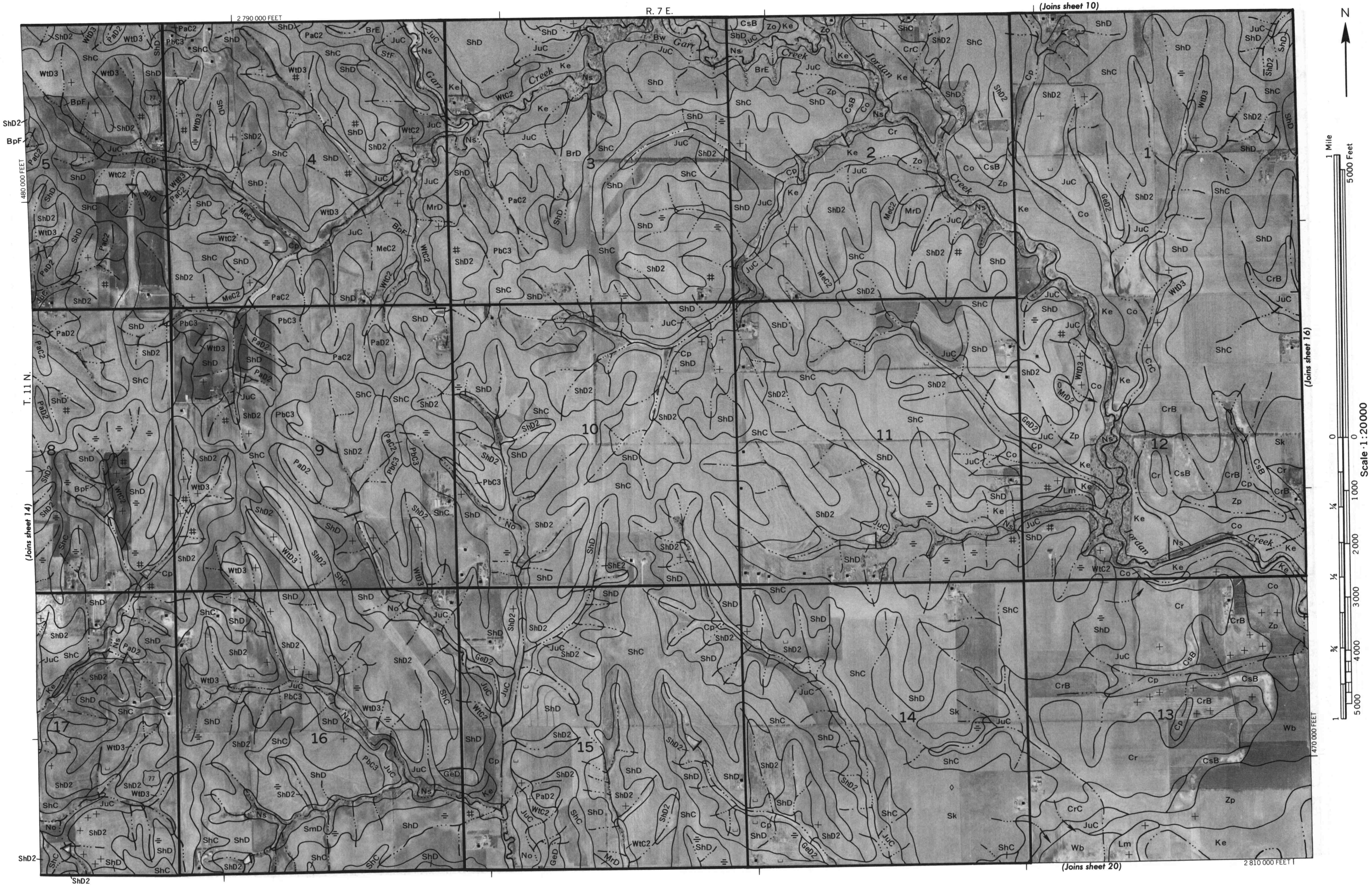

LANCASTER COUNTY, NEBRASKA NO. 15

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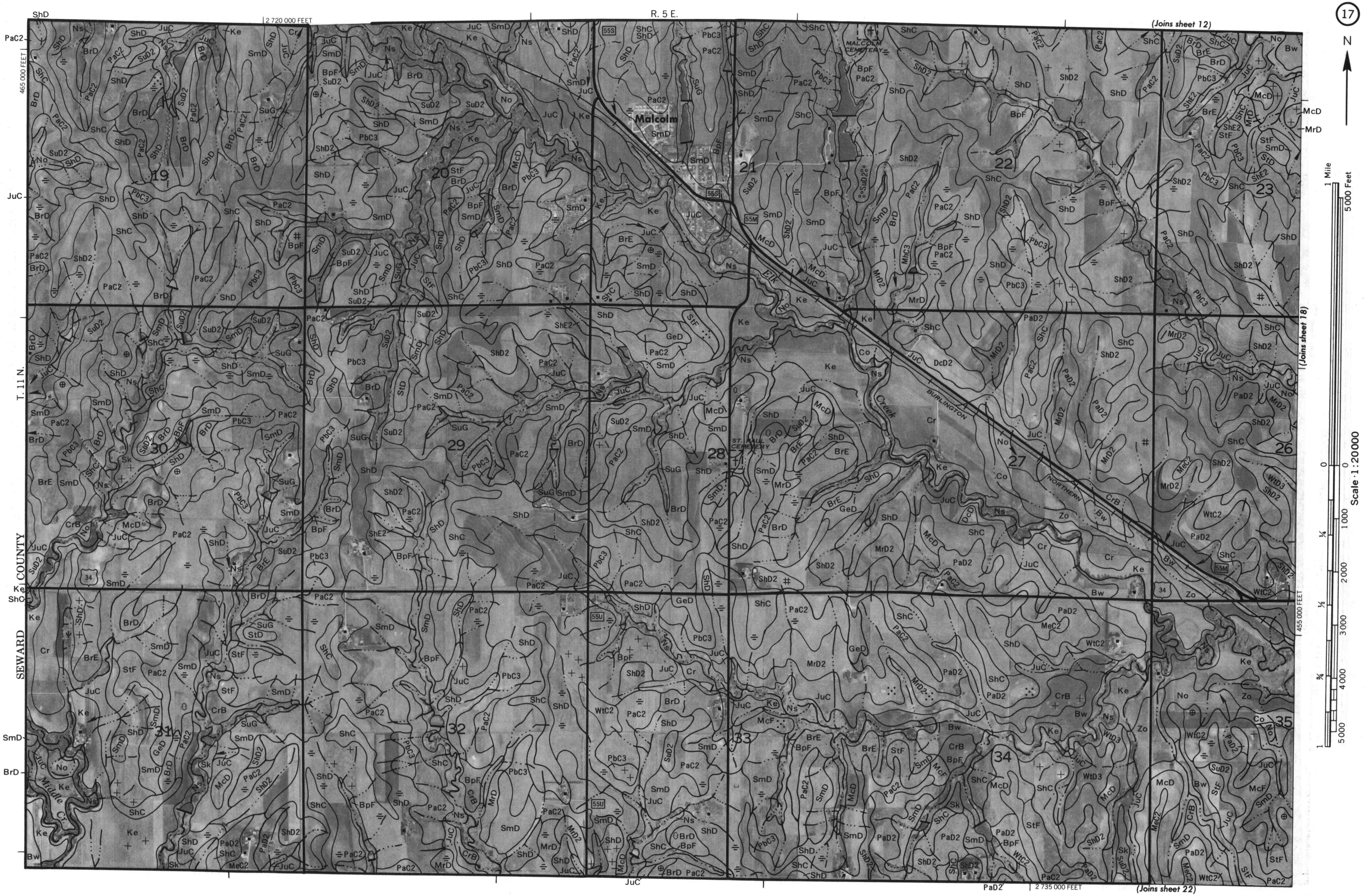

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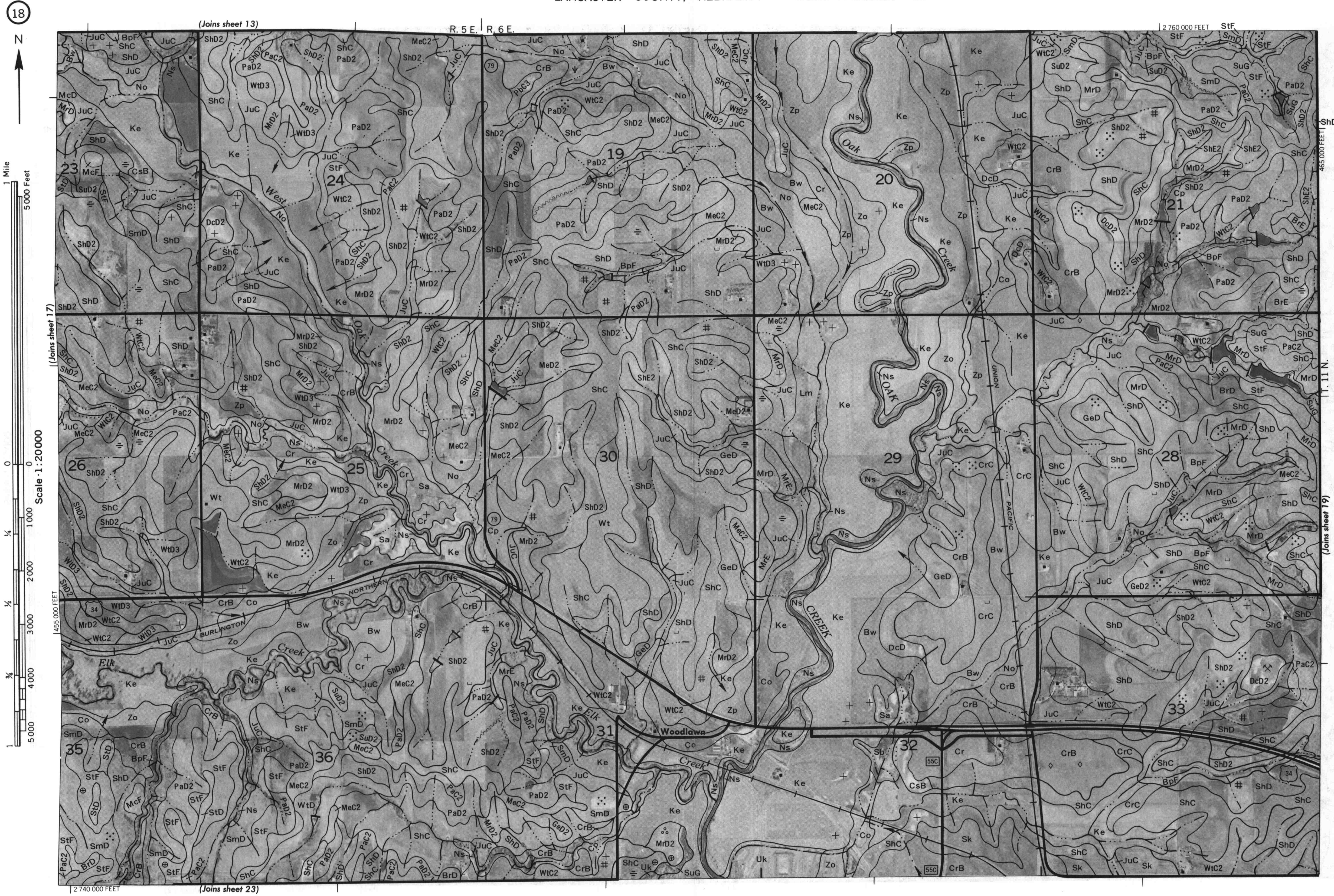

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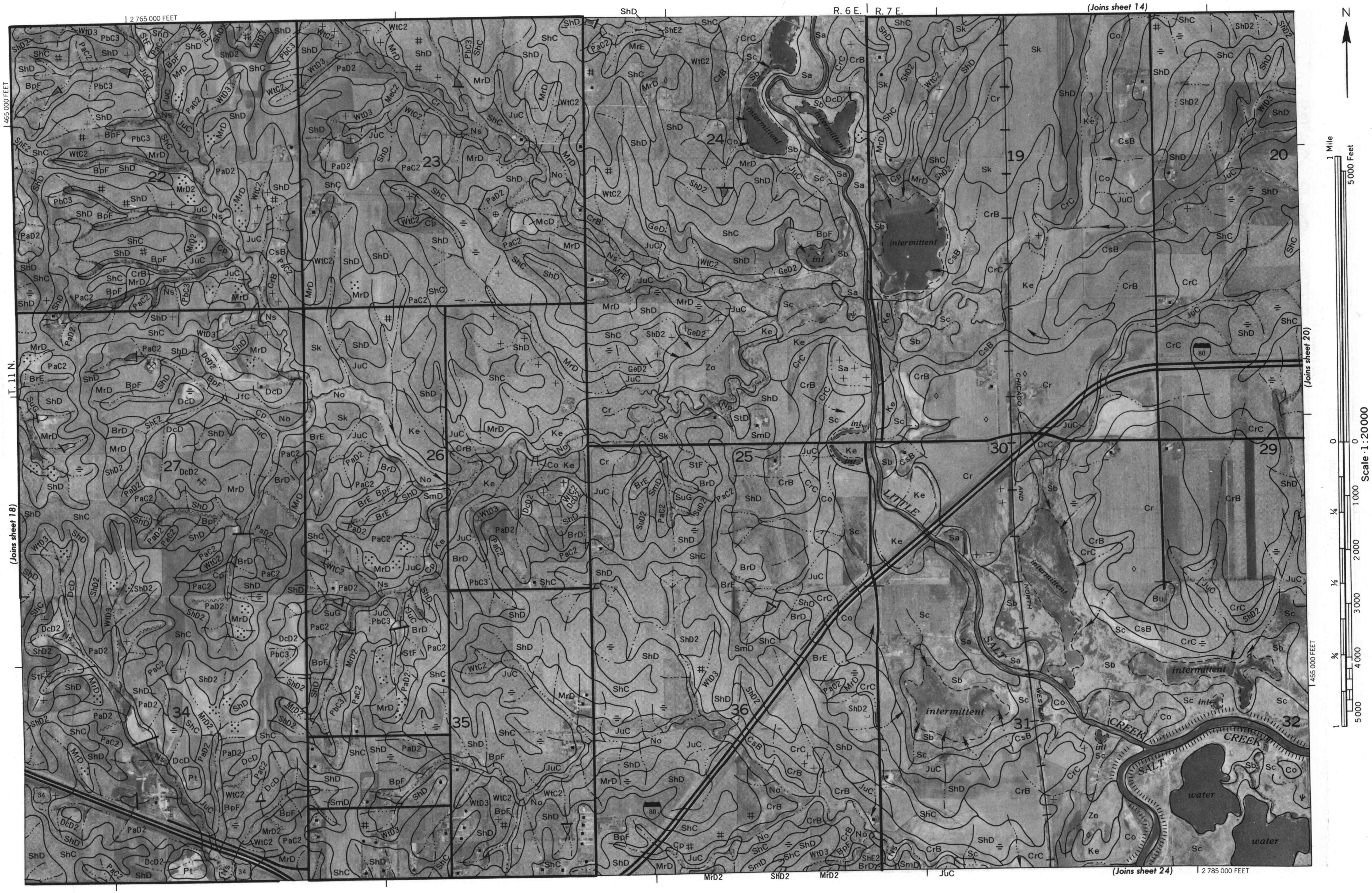

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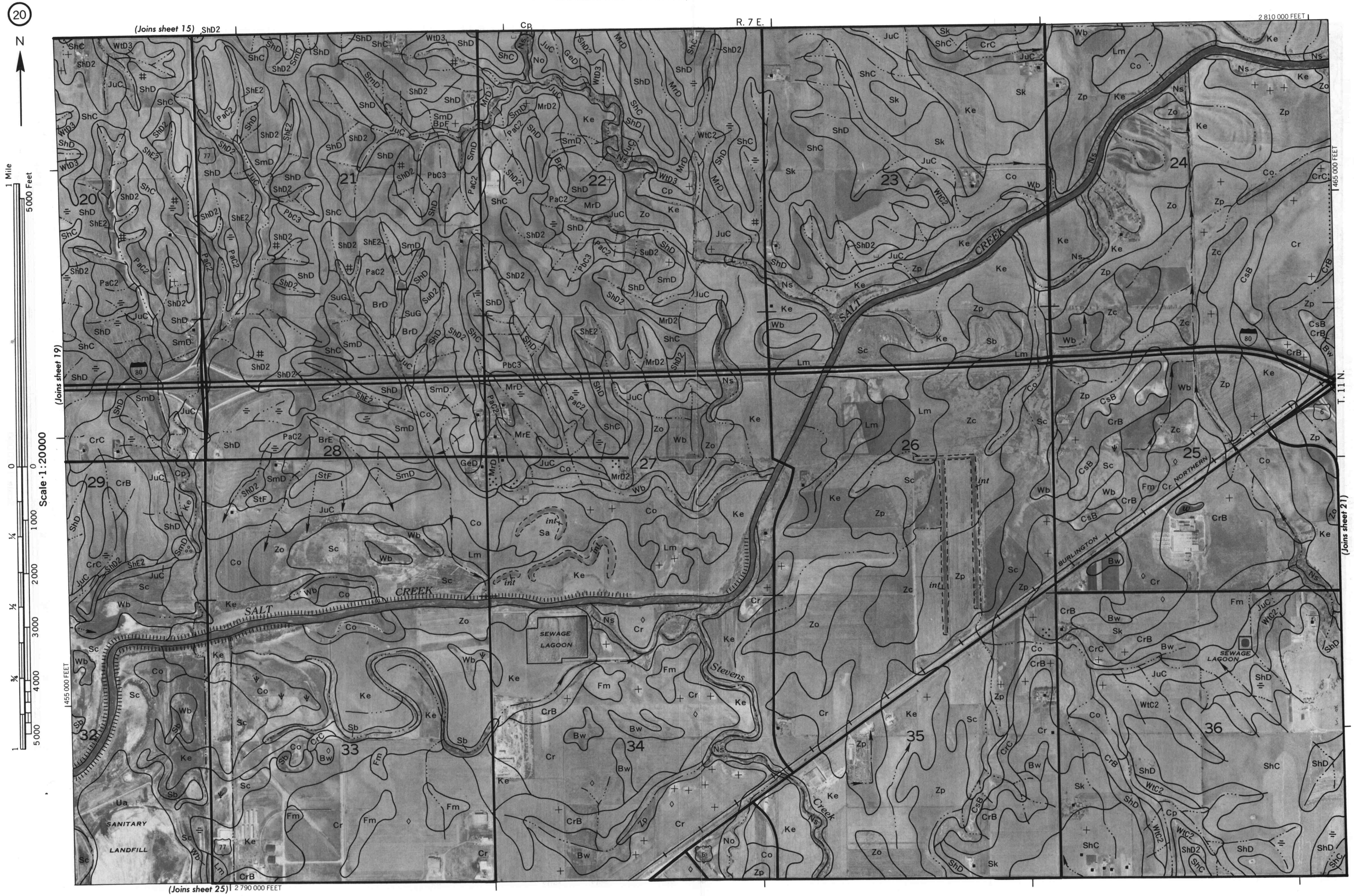

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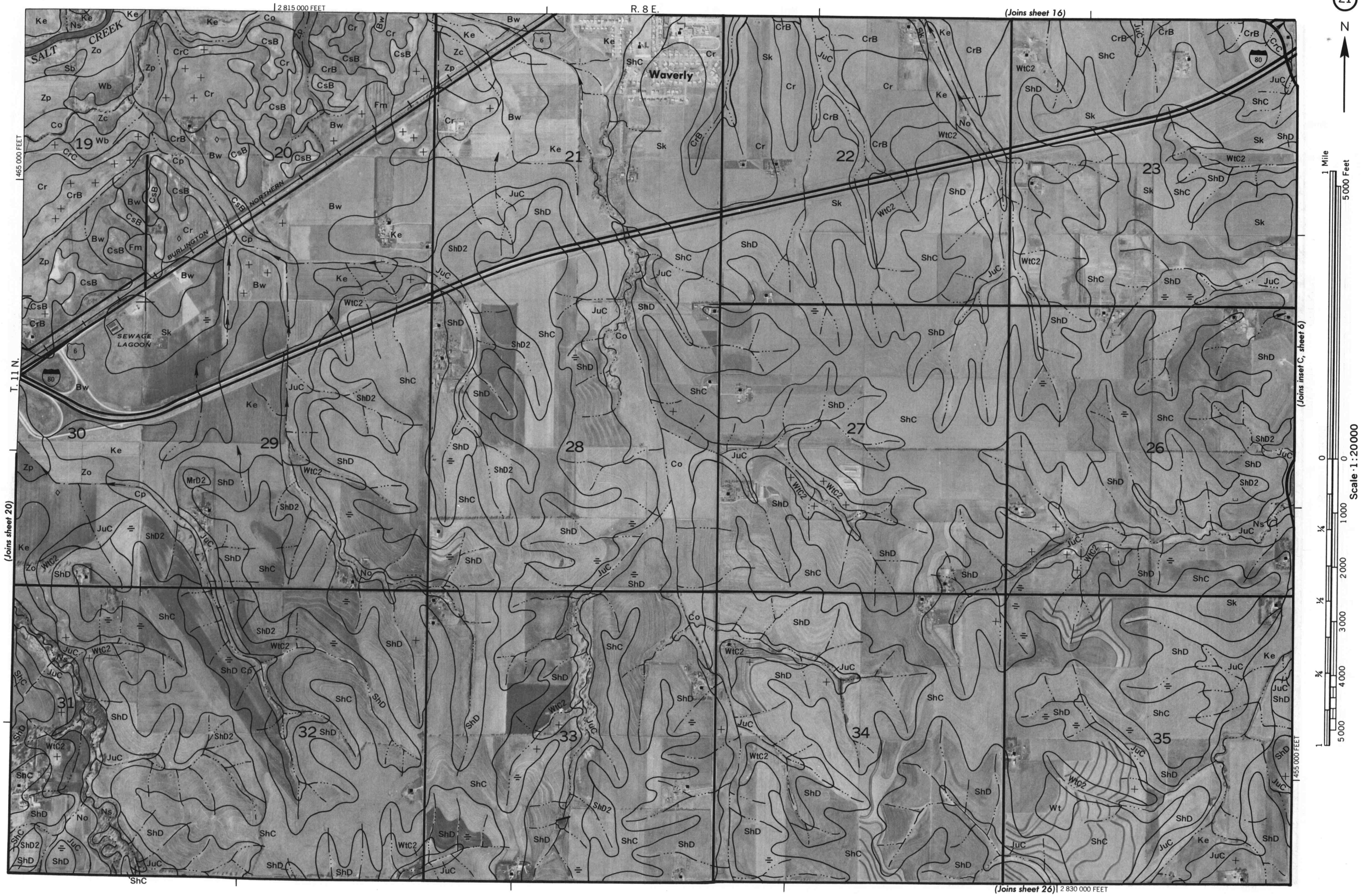

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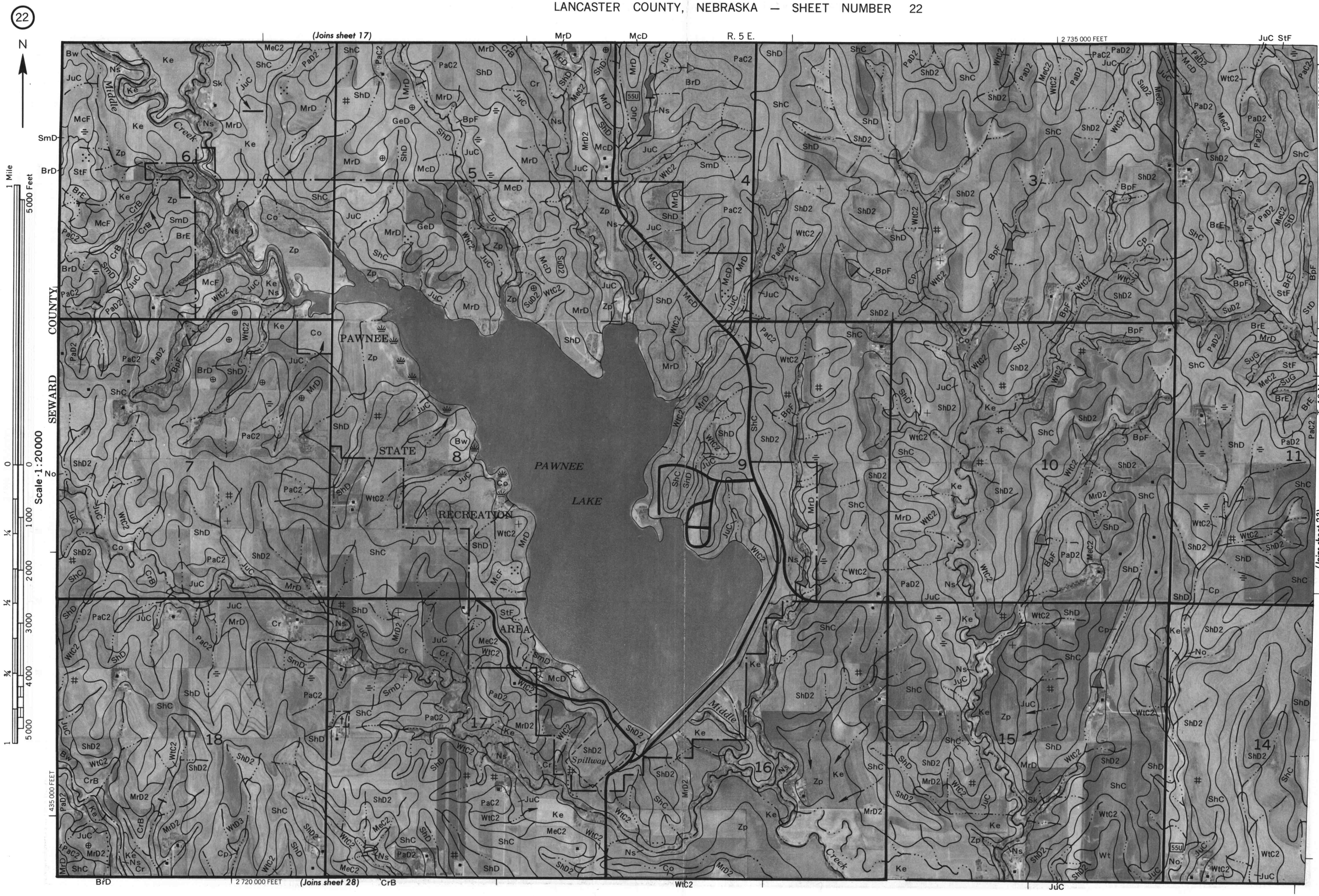

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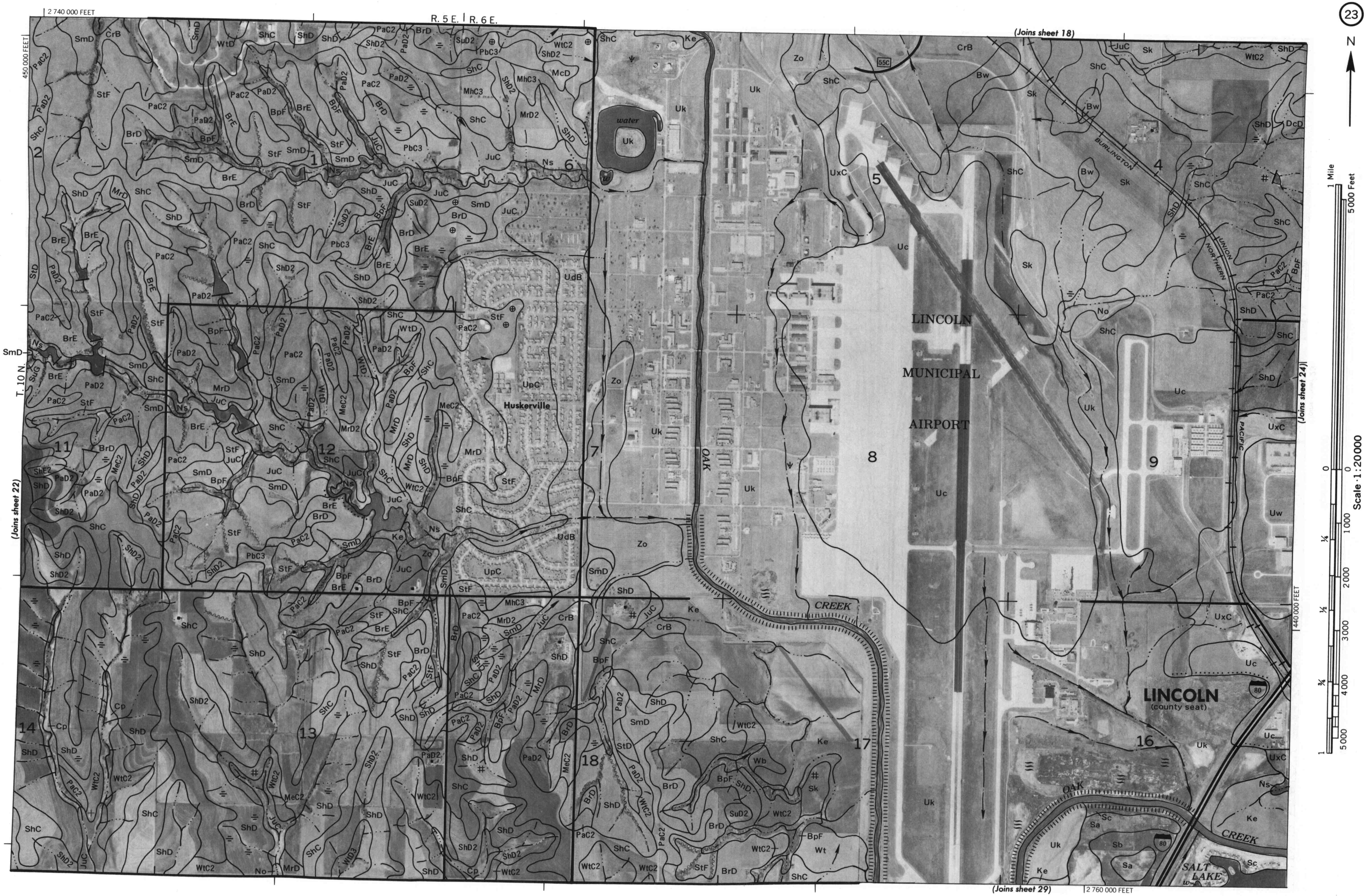

LANCASTER COUNTY, NEBRASKA NO. 23

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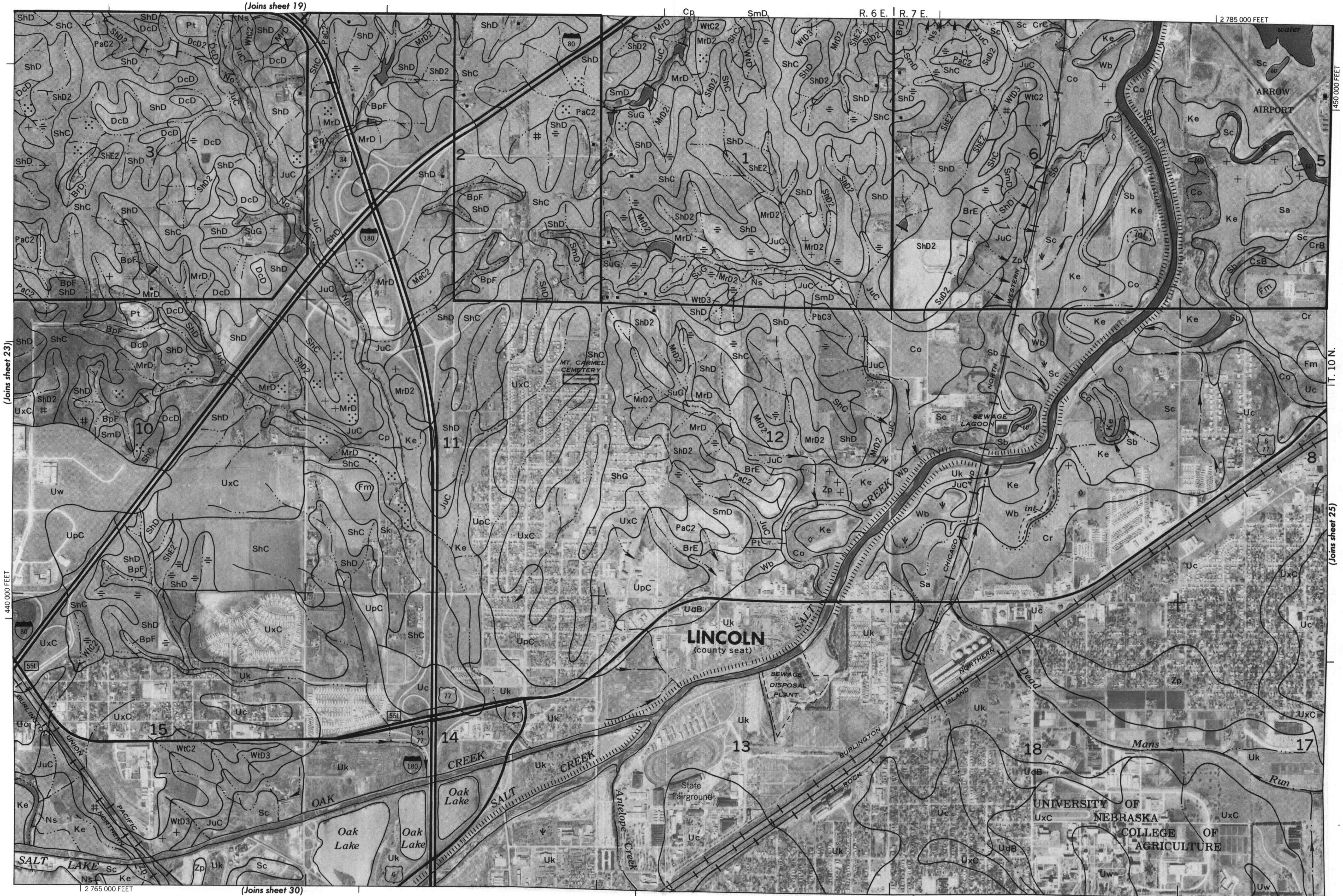
N



1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

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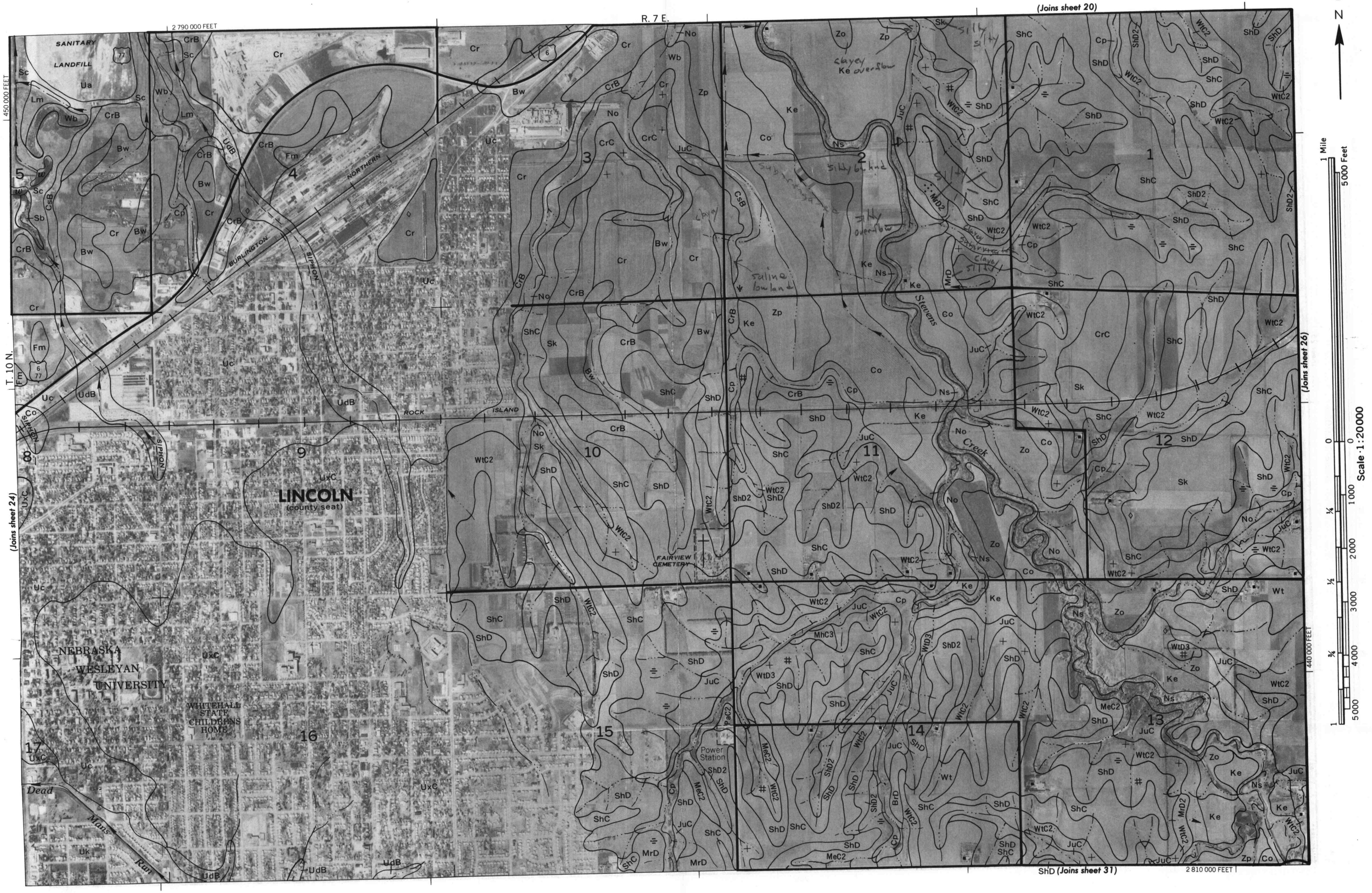
LANCASTER COUNTY, NEBRASKA NO. 24



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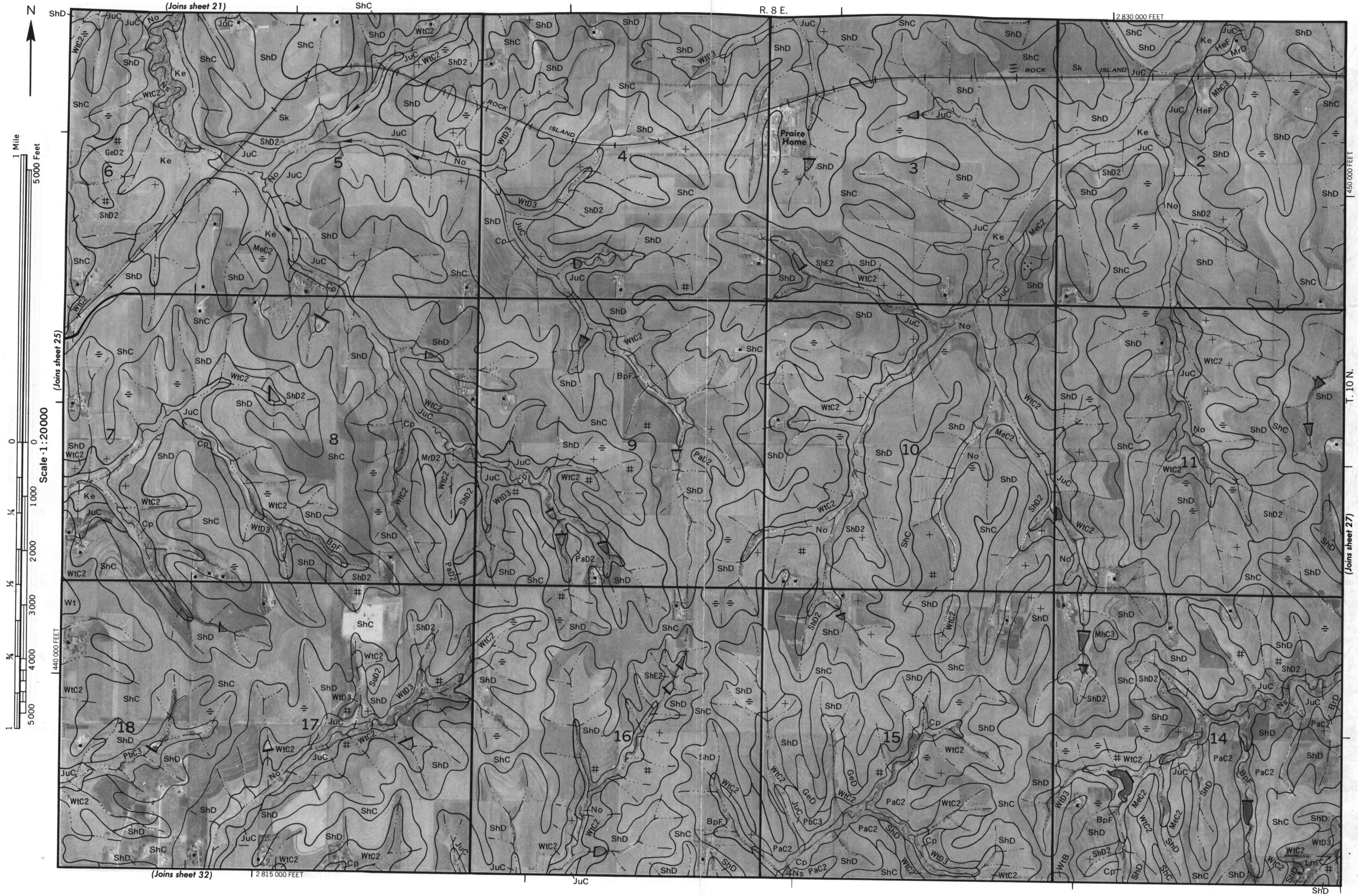

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4000 AND 5000-FOOT GRID TICKS

4000 AND 5000-FOOT GRID TICKS

3000 AND 5000-FOOT GRID TICKS

4000 AND 5000-FOOT GRID TICKS

LANCASTER COUNTY, NEBRASKA NO. 27

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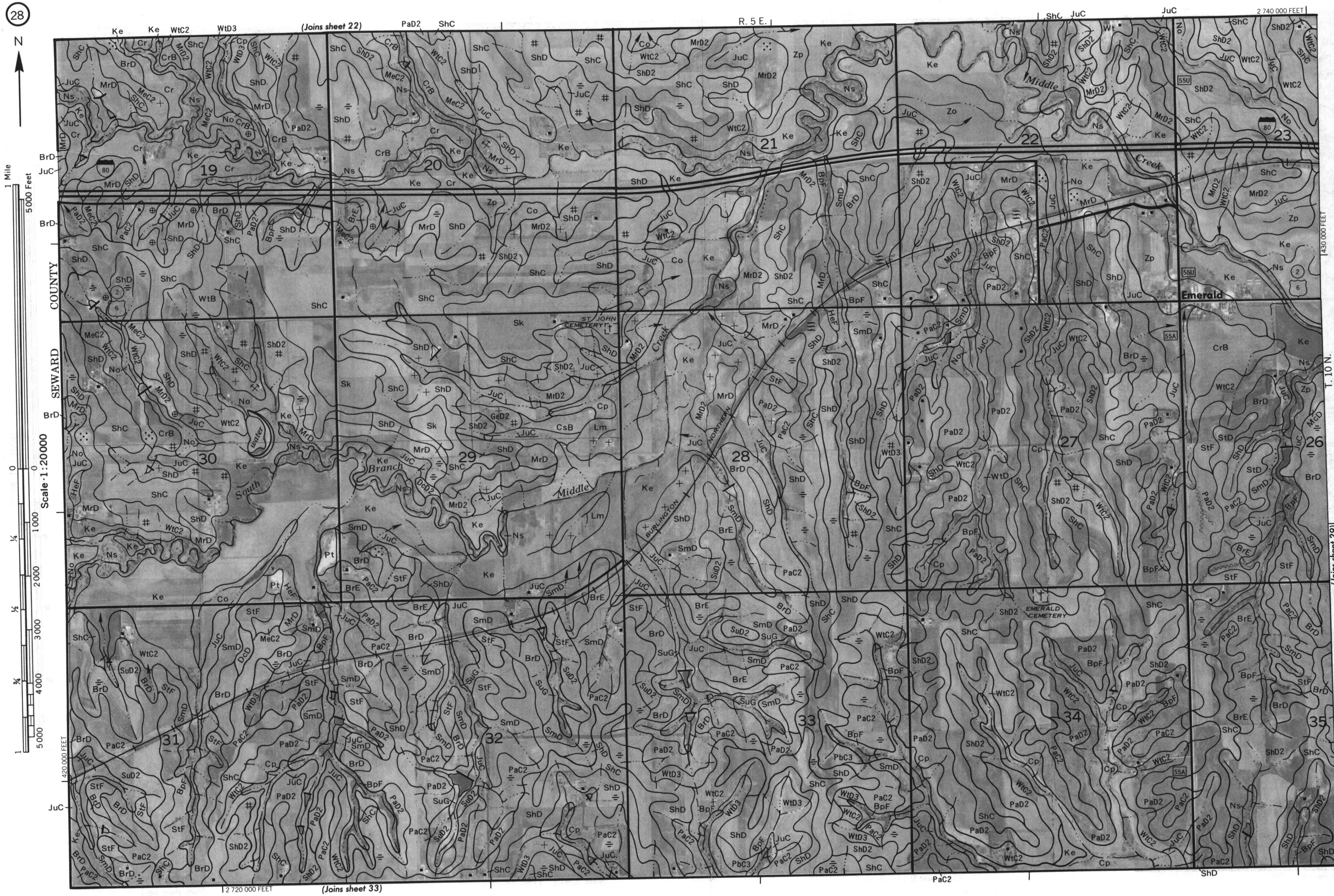

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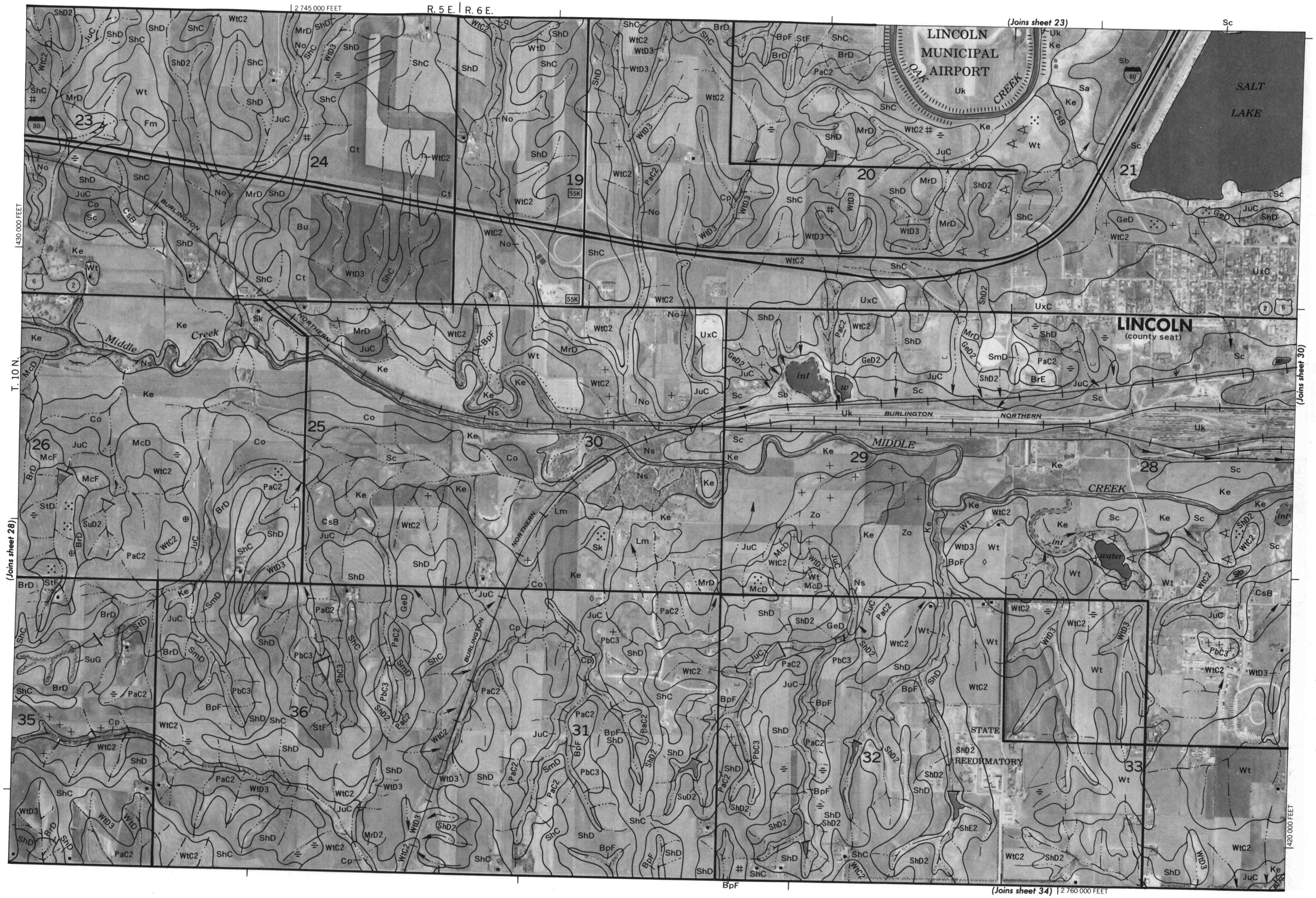
(29)

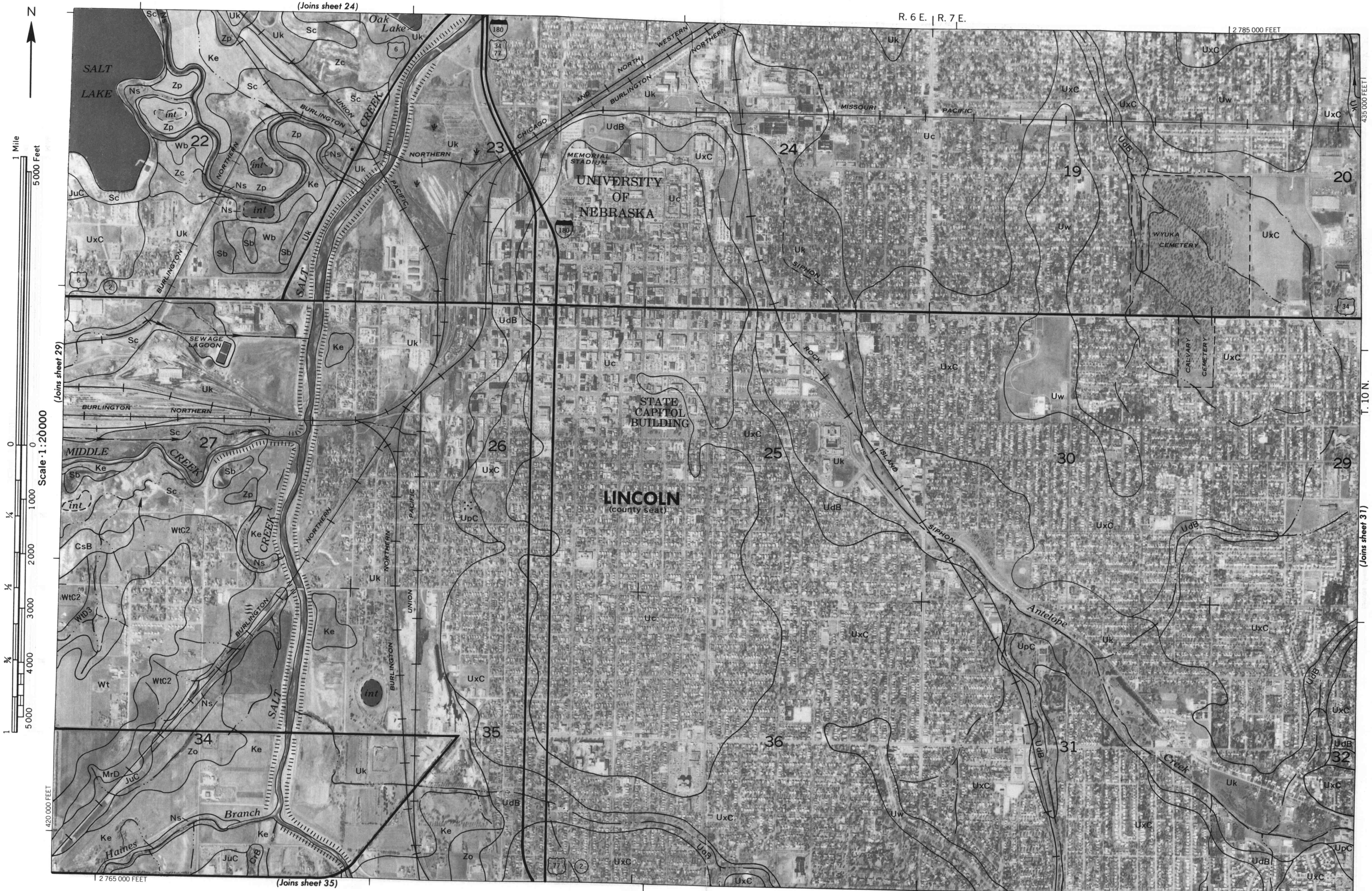


N

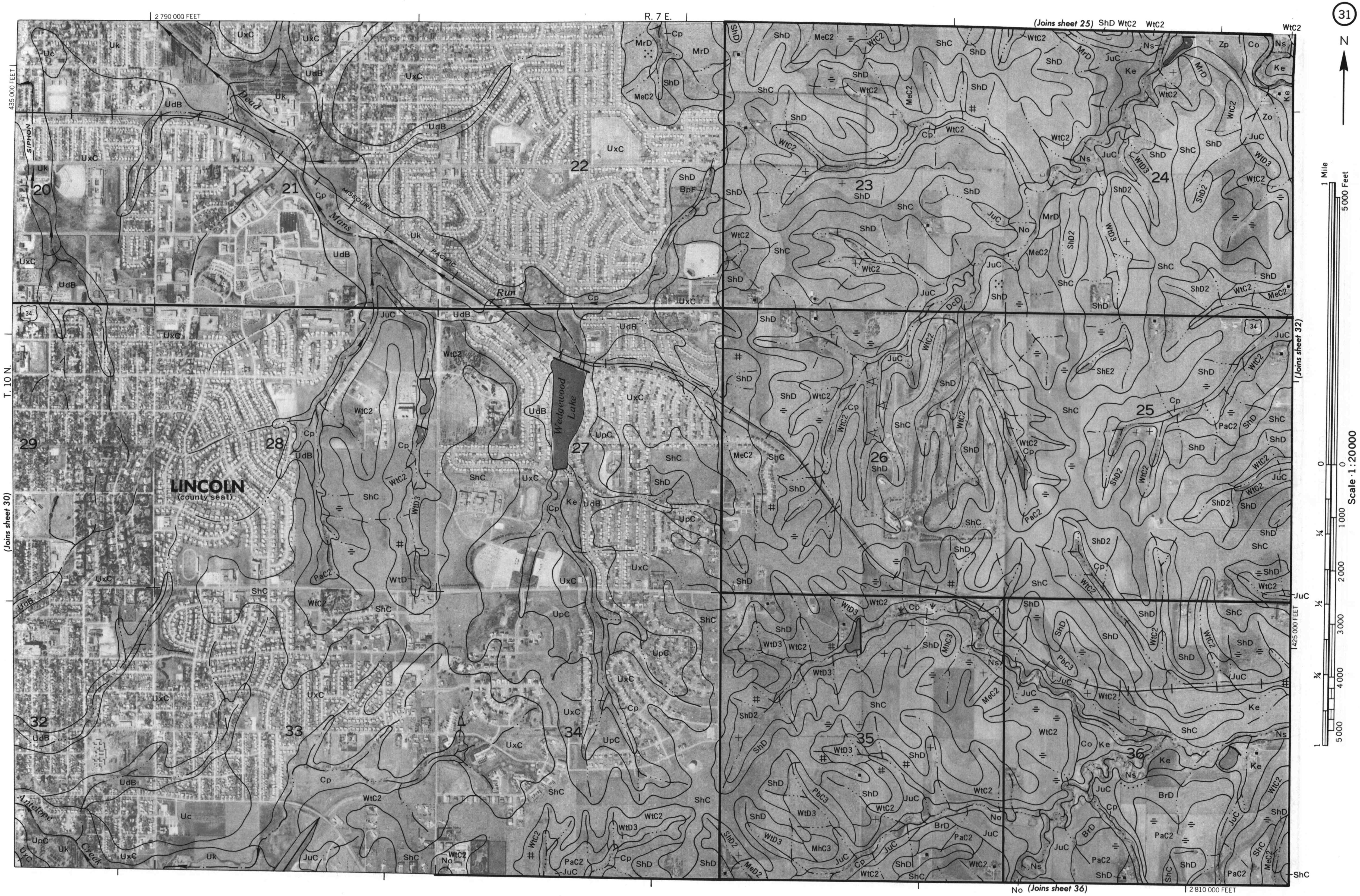
1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

LANCASTER COUNTY, NEBRASKA NO. 29

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

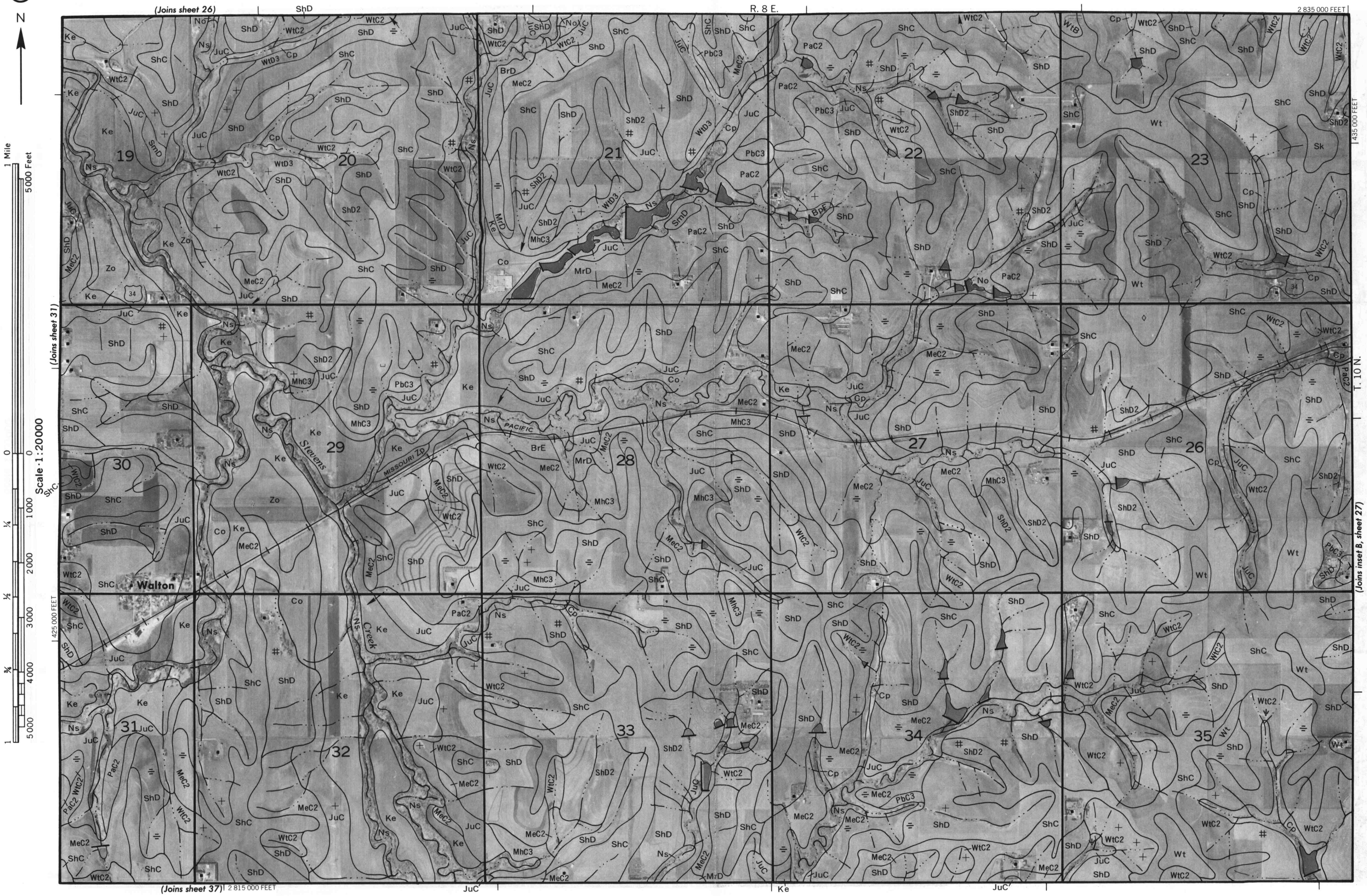


This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 31

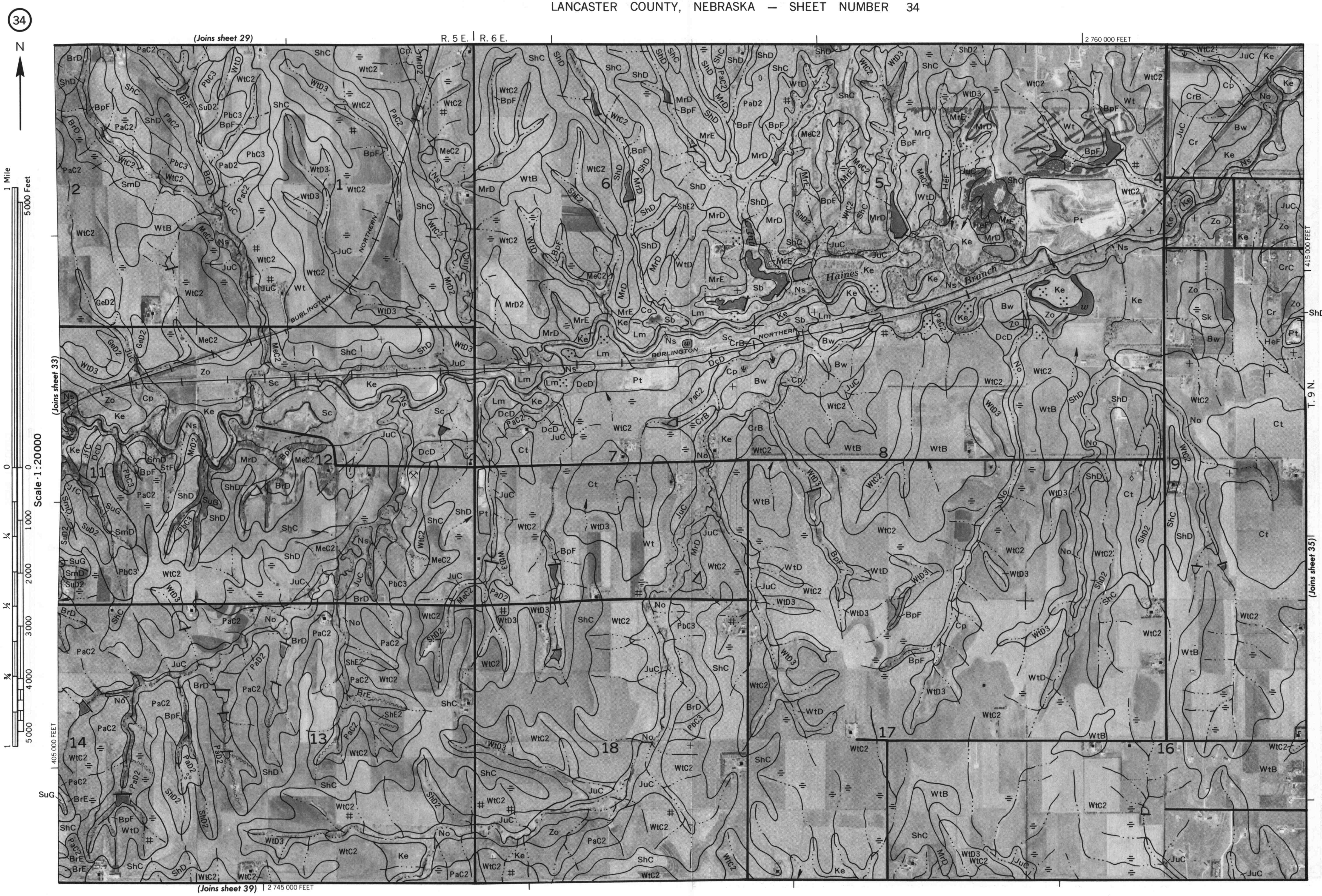
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



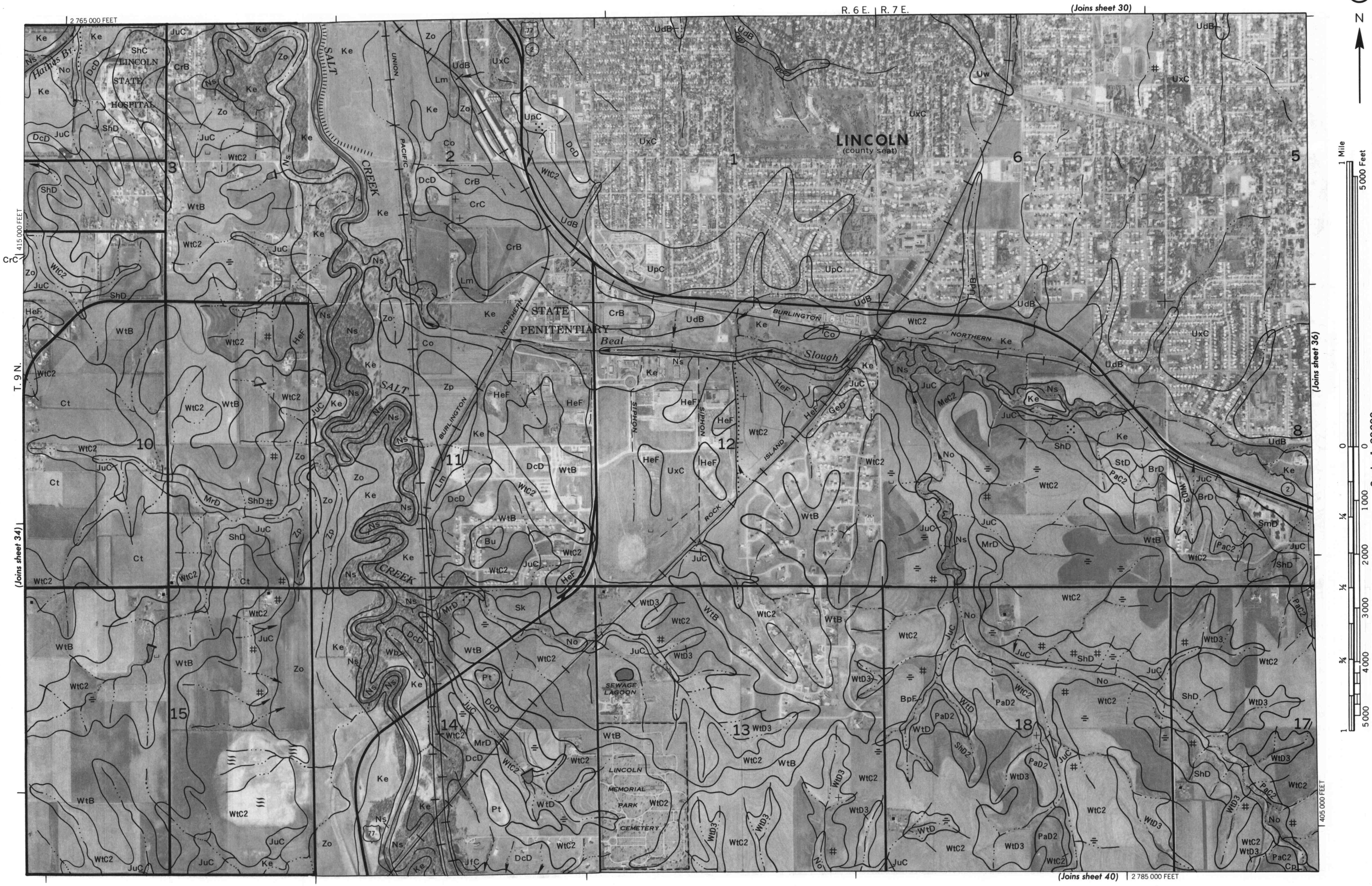
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

LANCASTER COUNTY, NEBRASKA NO. 33

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA, NO. 35

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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LANCASTER COUNTY, NEBRASKA NO. 37

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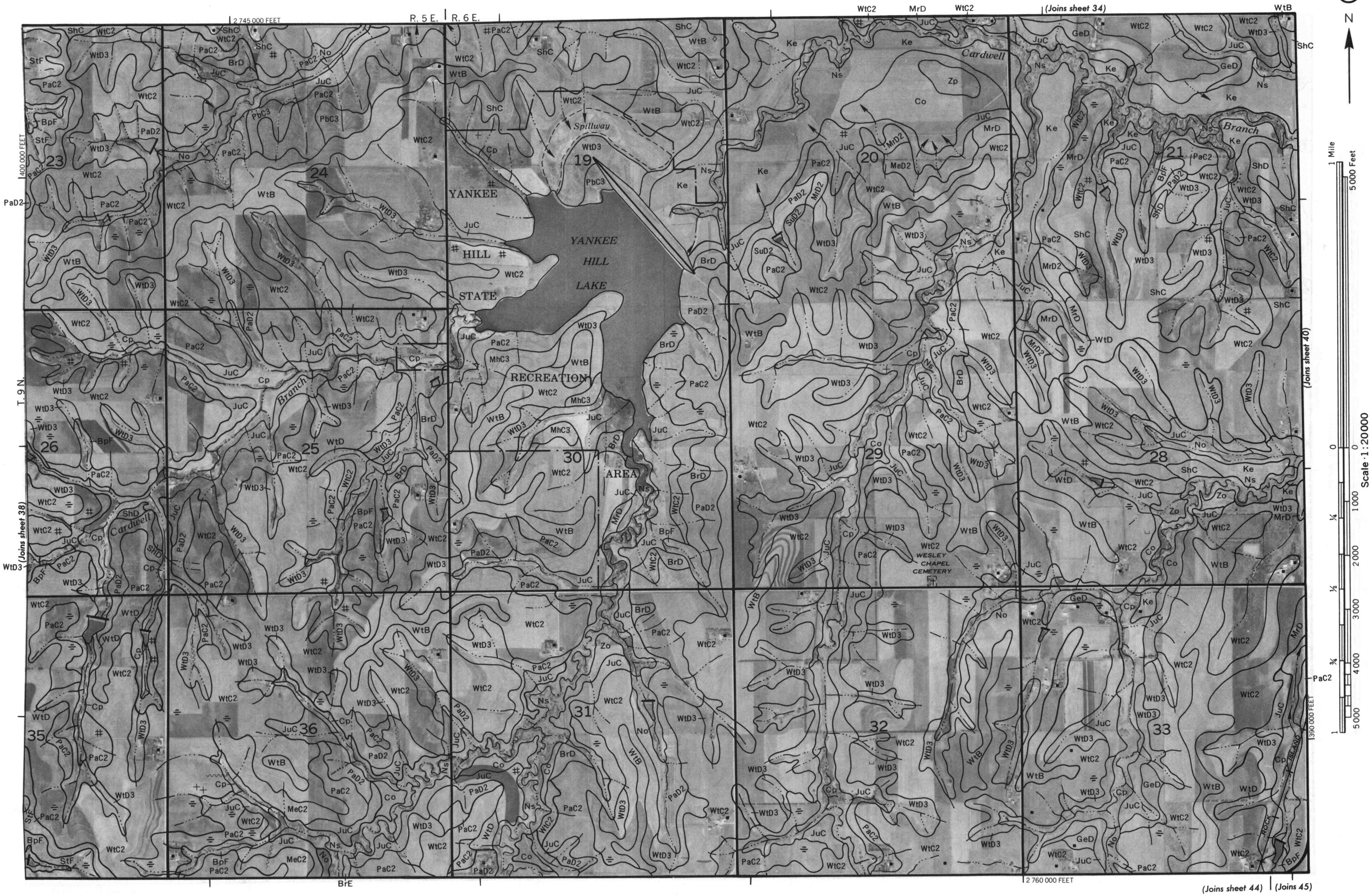
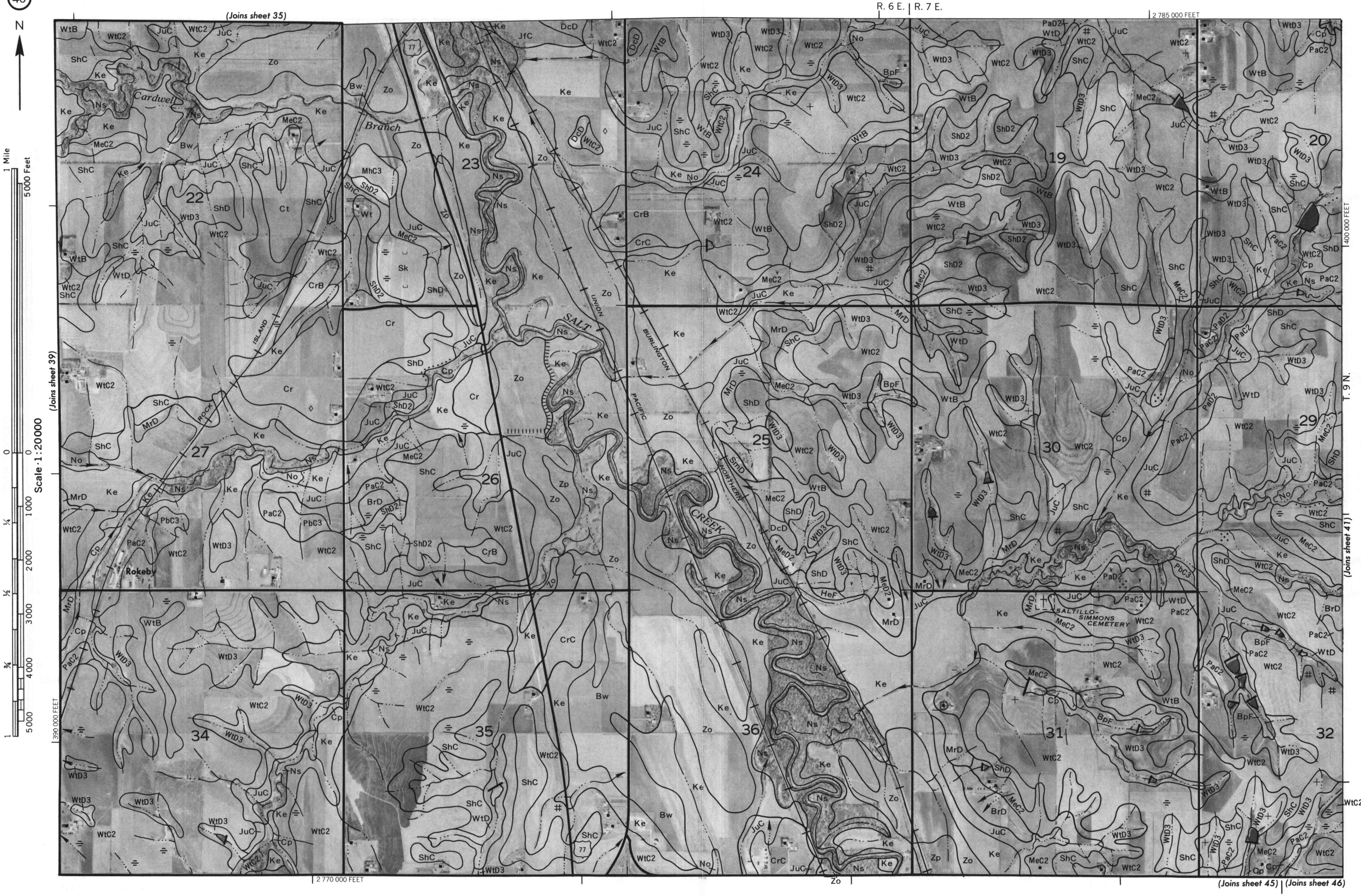
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

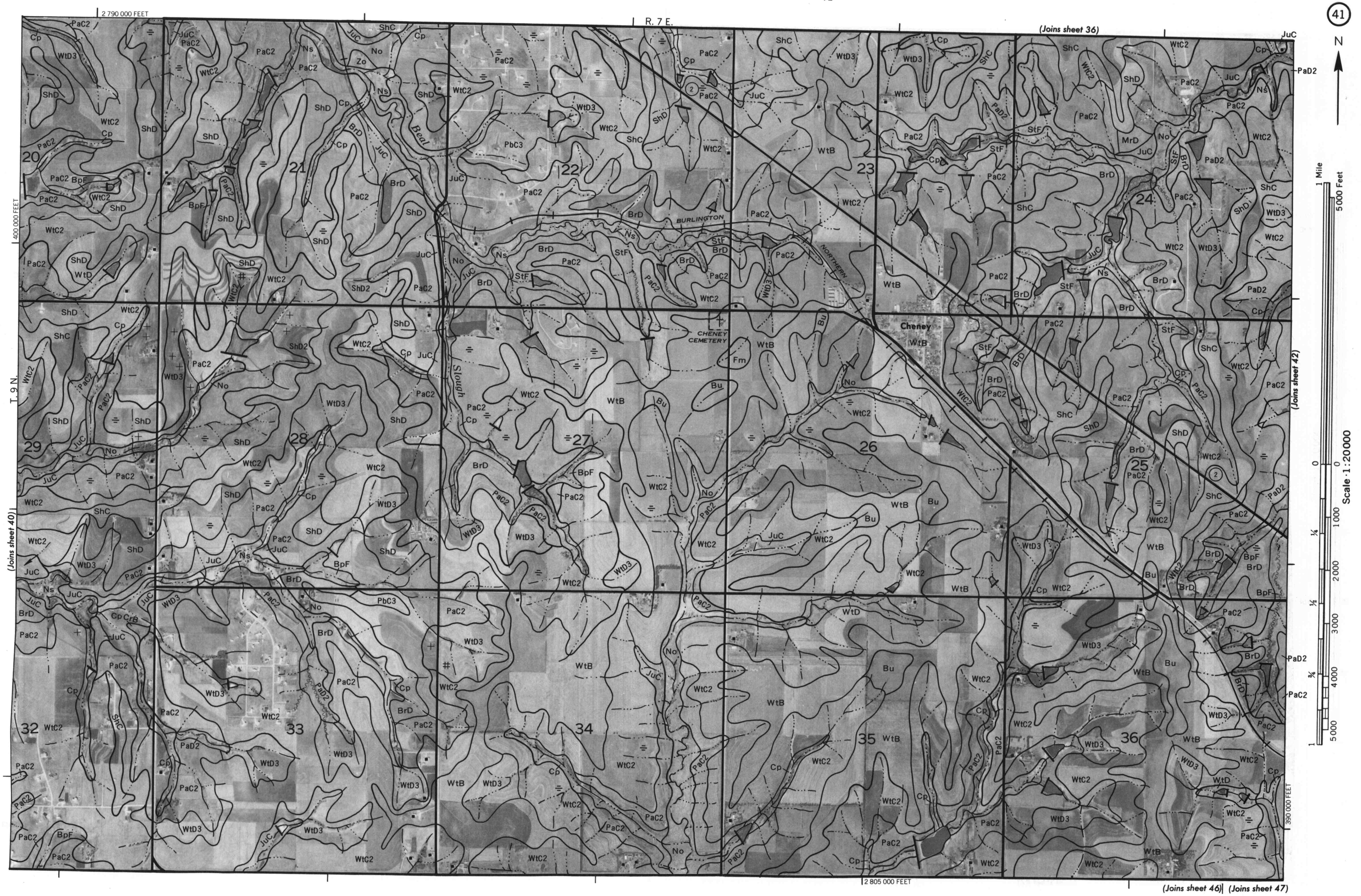


LANCASTER COUNTY, NEBRASKA NO. 39

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

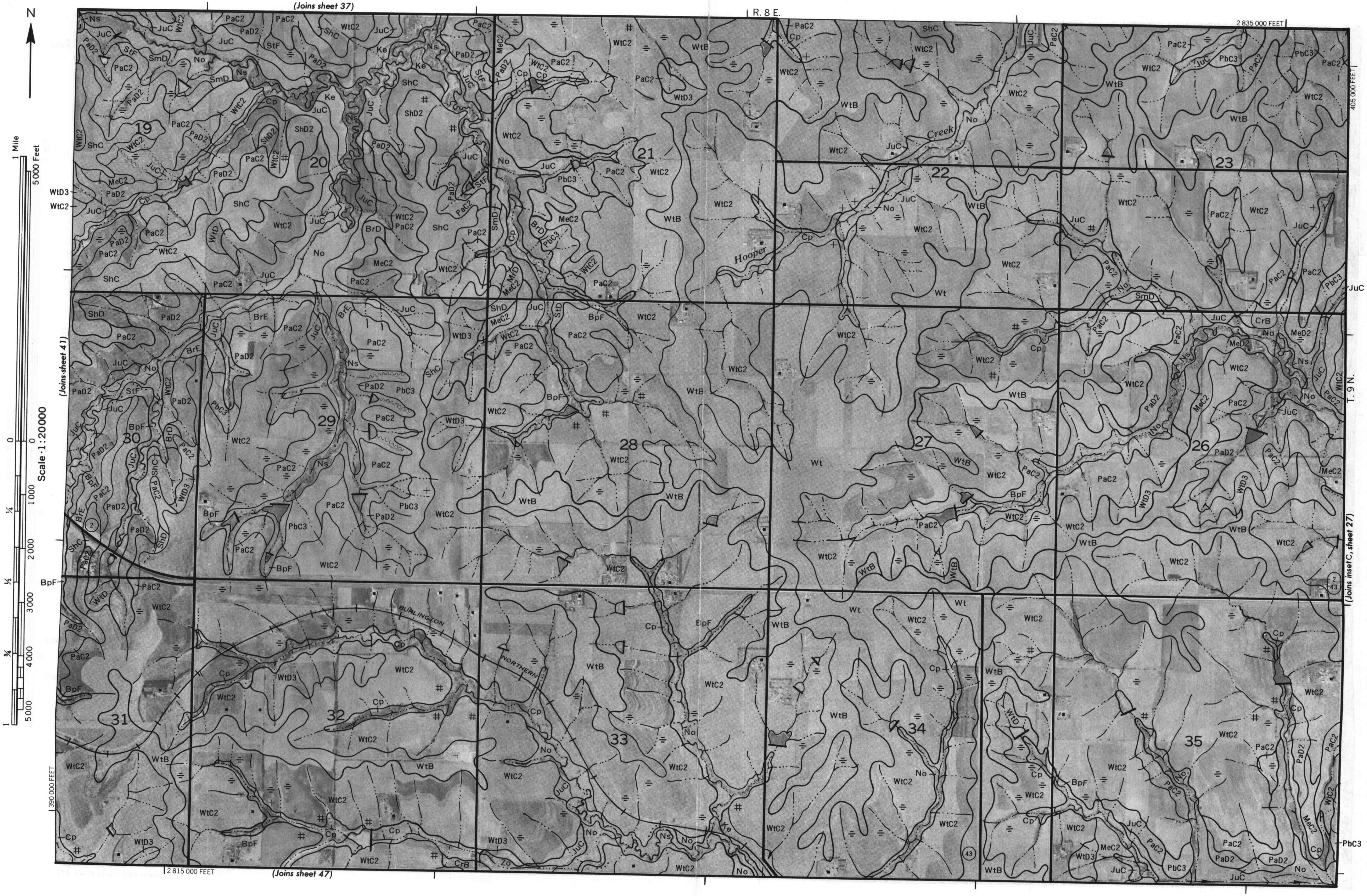


This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

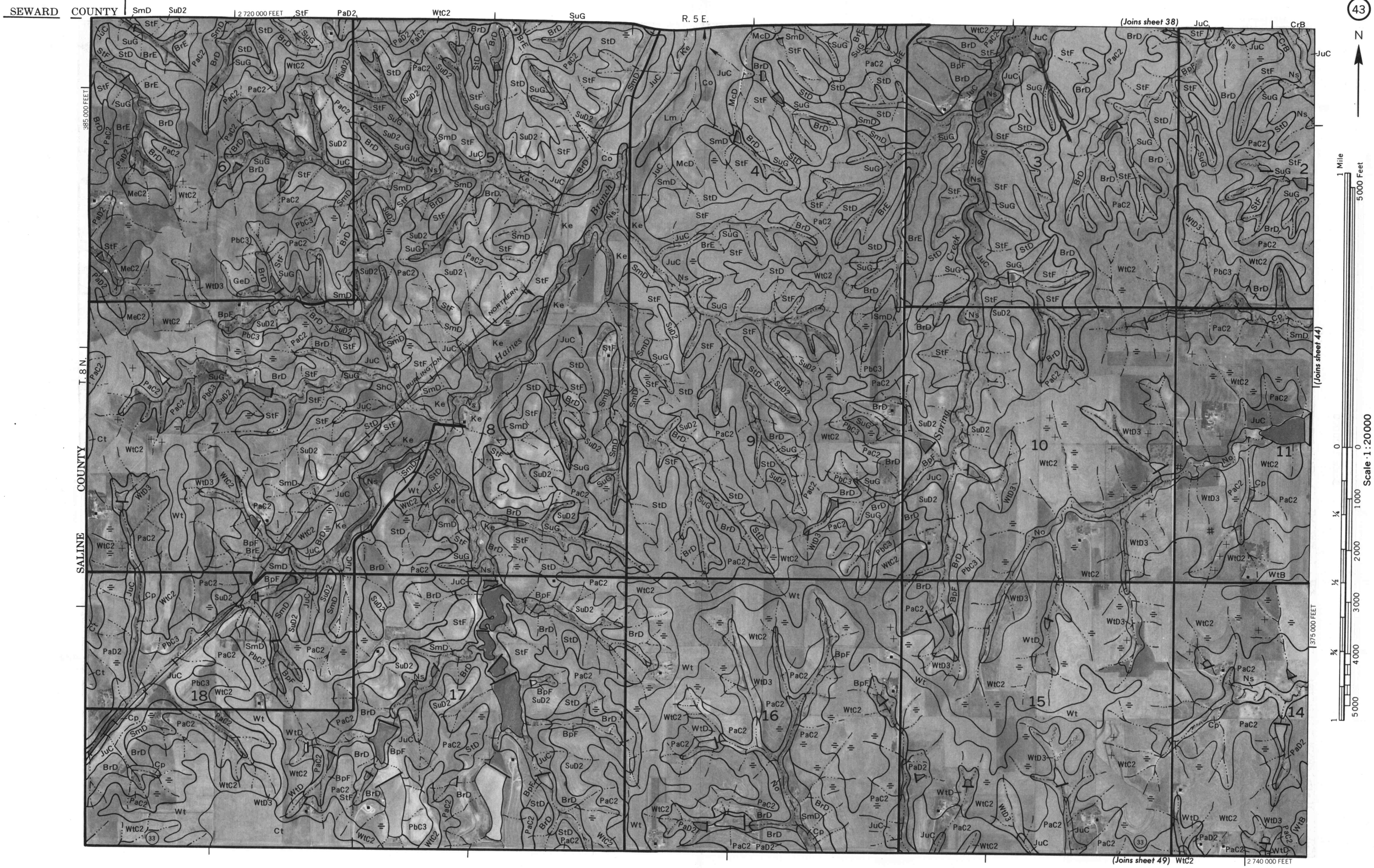


LANCASTER COUNTY, NEBRASKA NO. 41

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 43

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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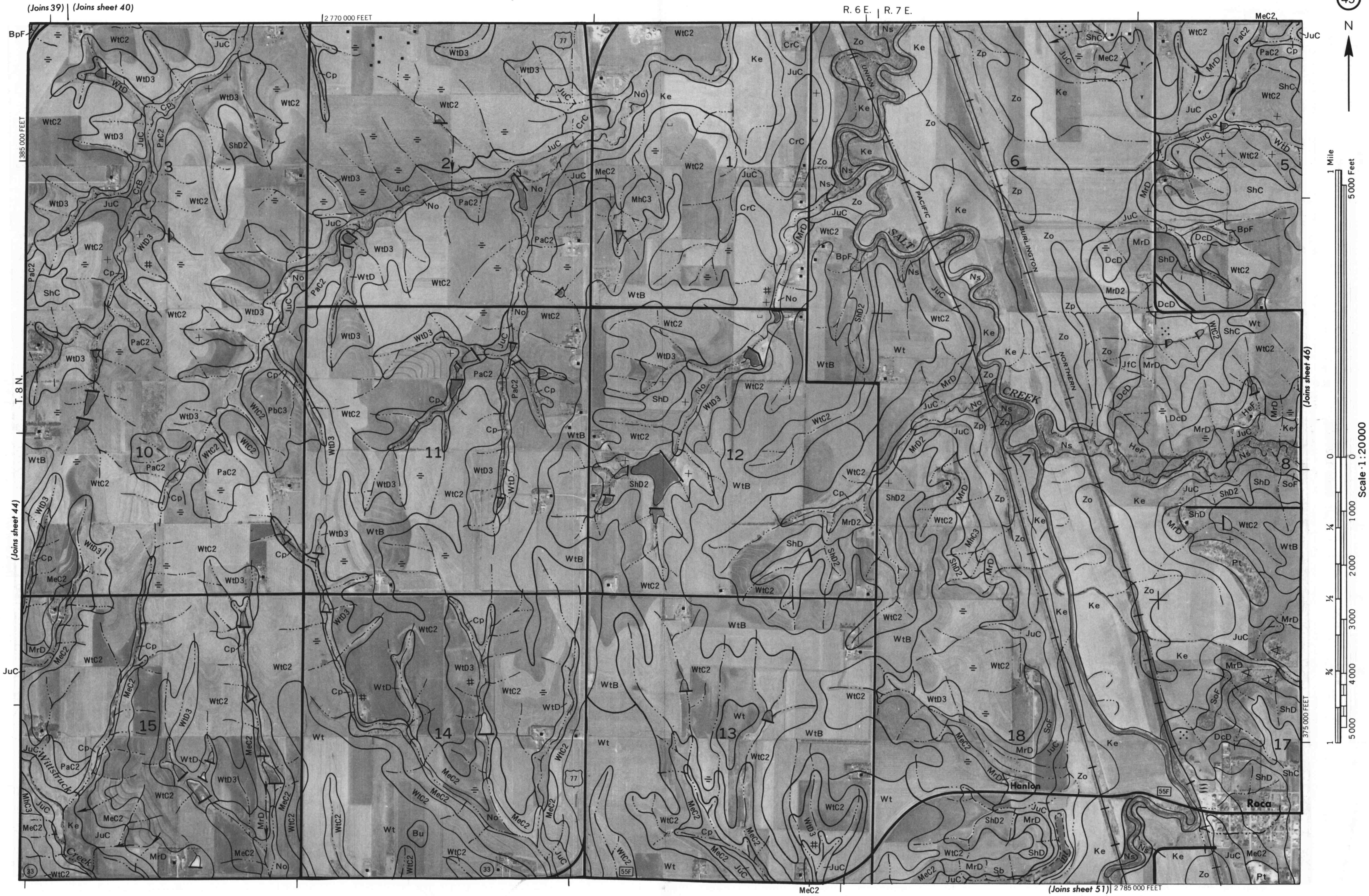
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 45

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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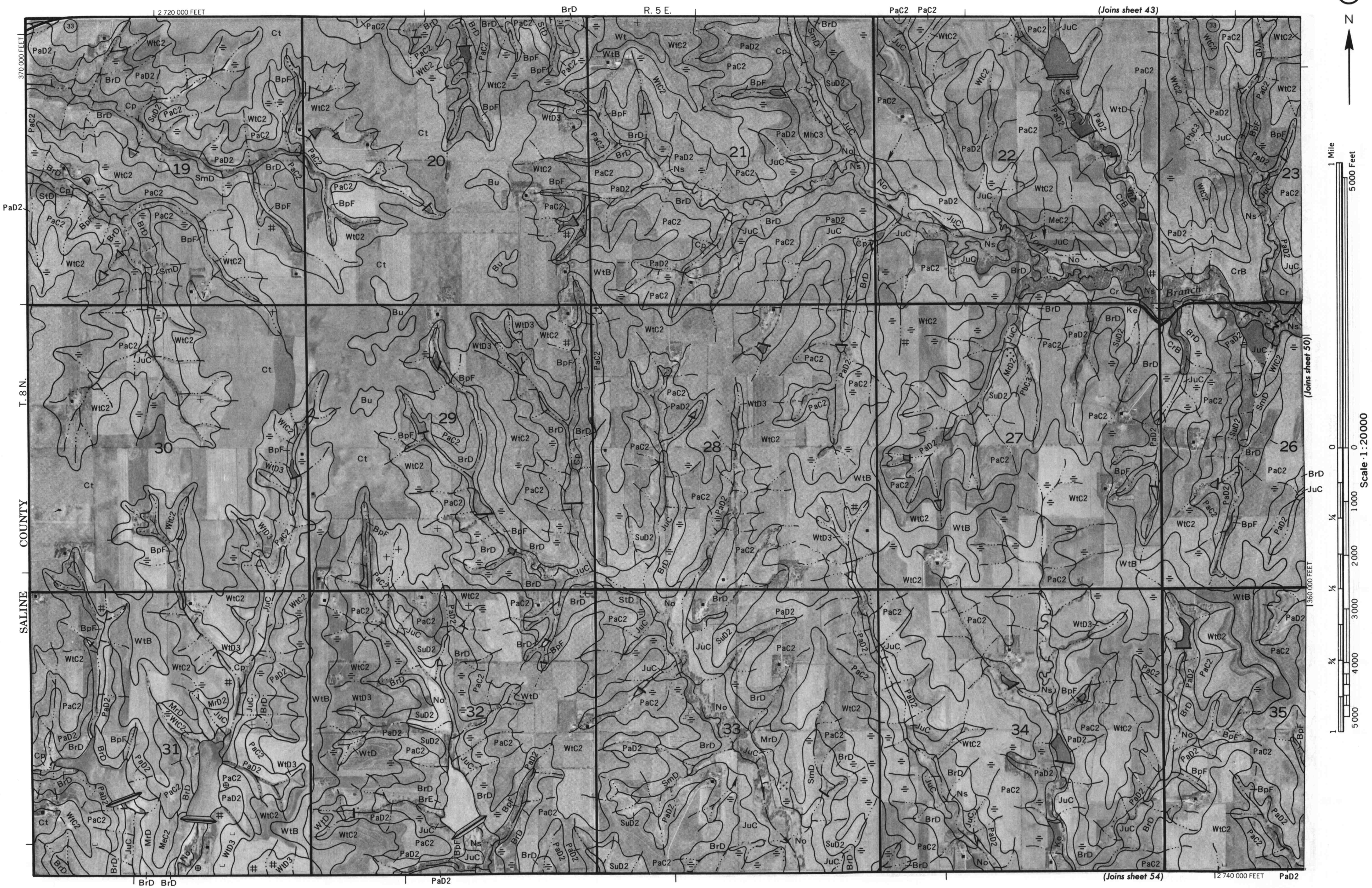
LANCASTER COUNTY, NEBRASKA NO. 47

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

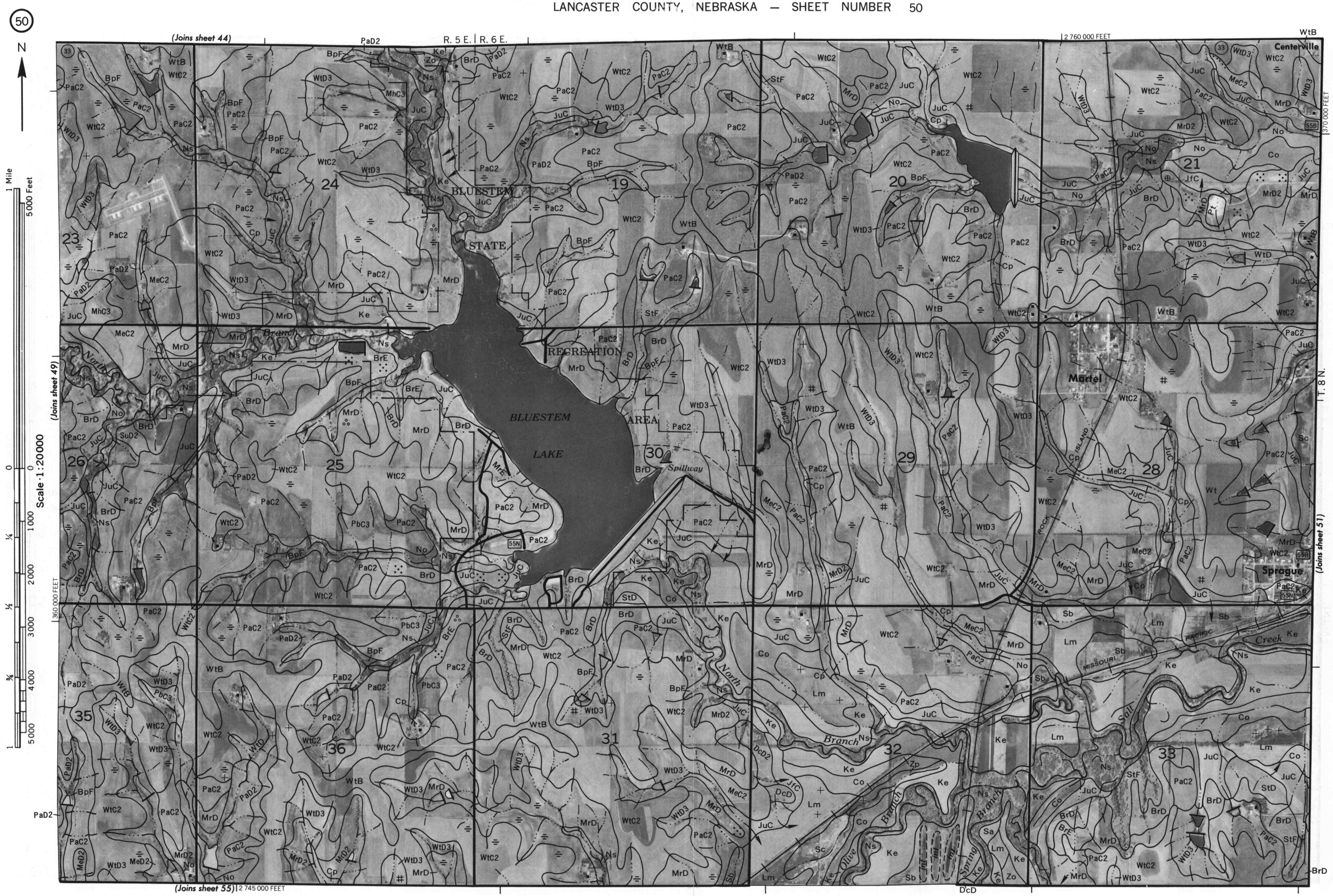
N

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
0
¼
½
¾
1
Scale 1:20000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



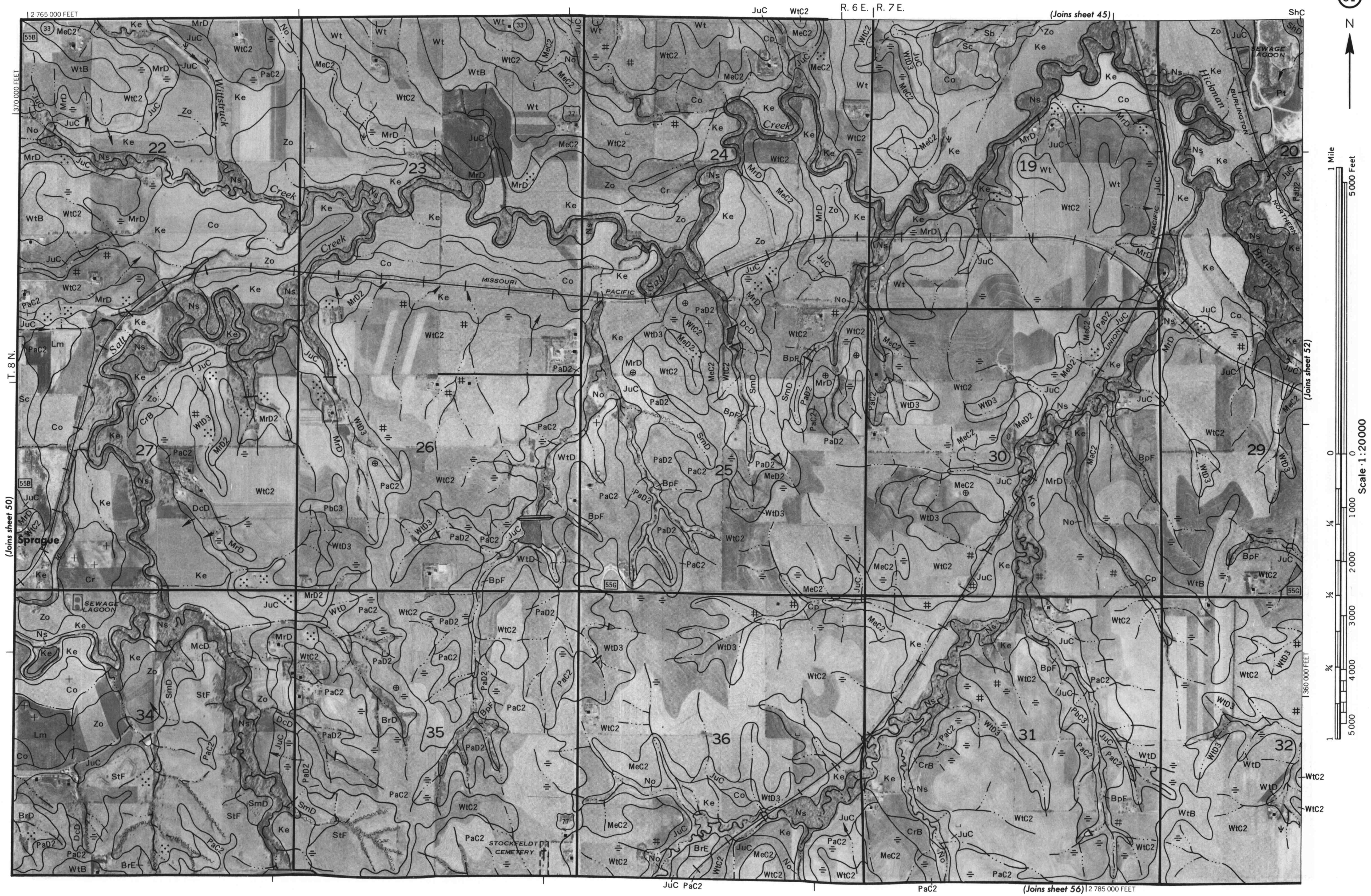
LANCASTER COUNTY, NEBRASKA NO. 49
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

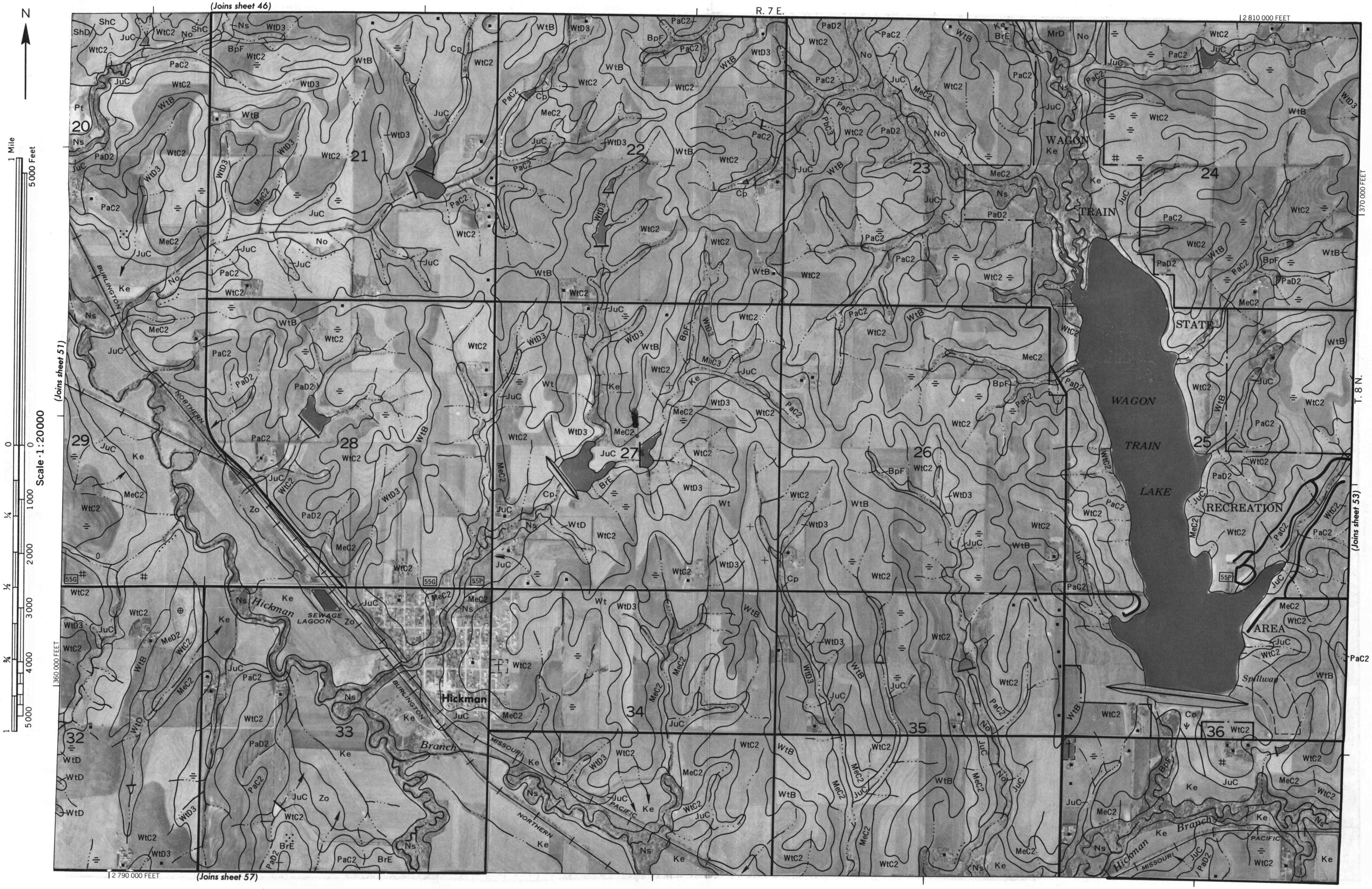


This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

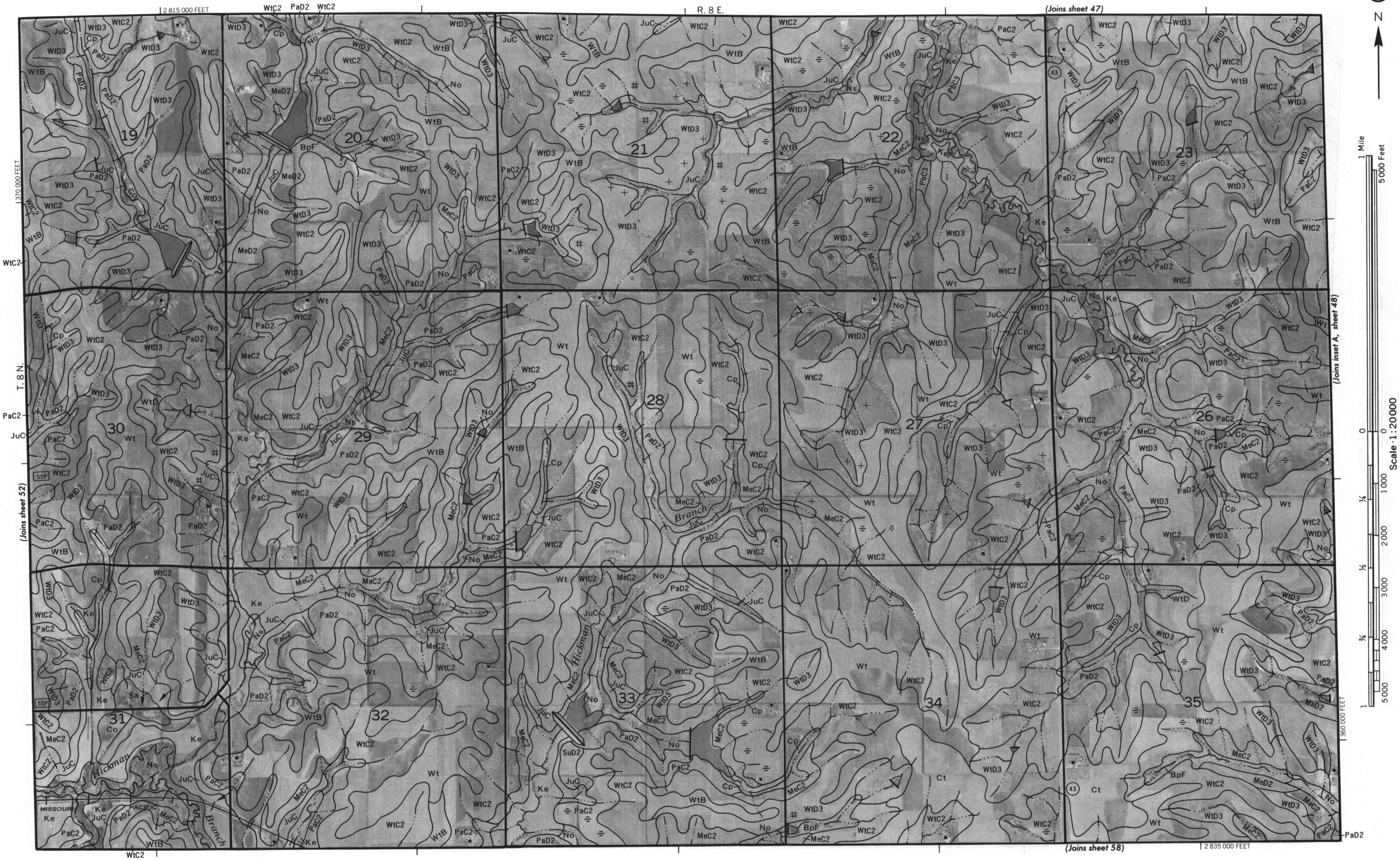
LANCASTER COUNTY, NEBRASKA NO. 51

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



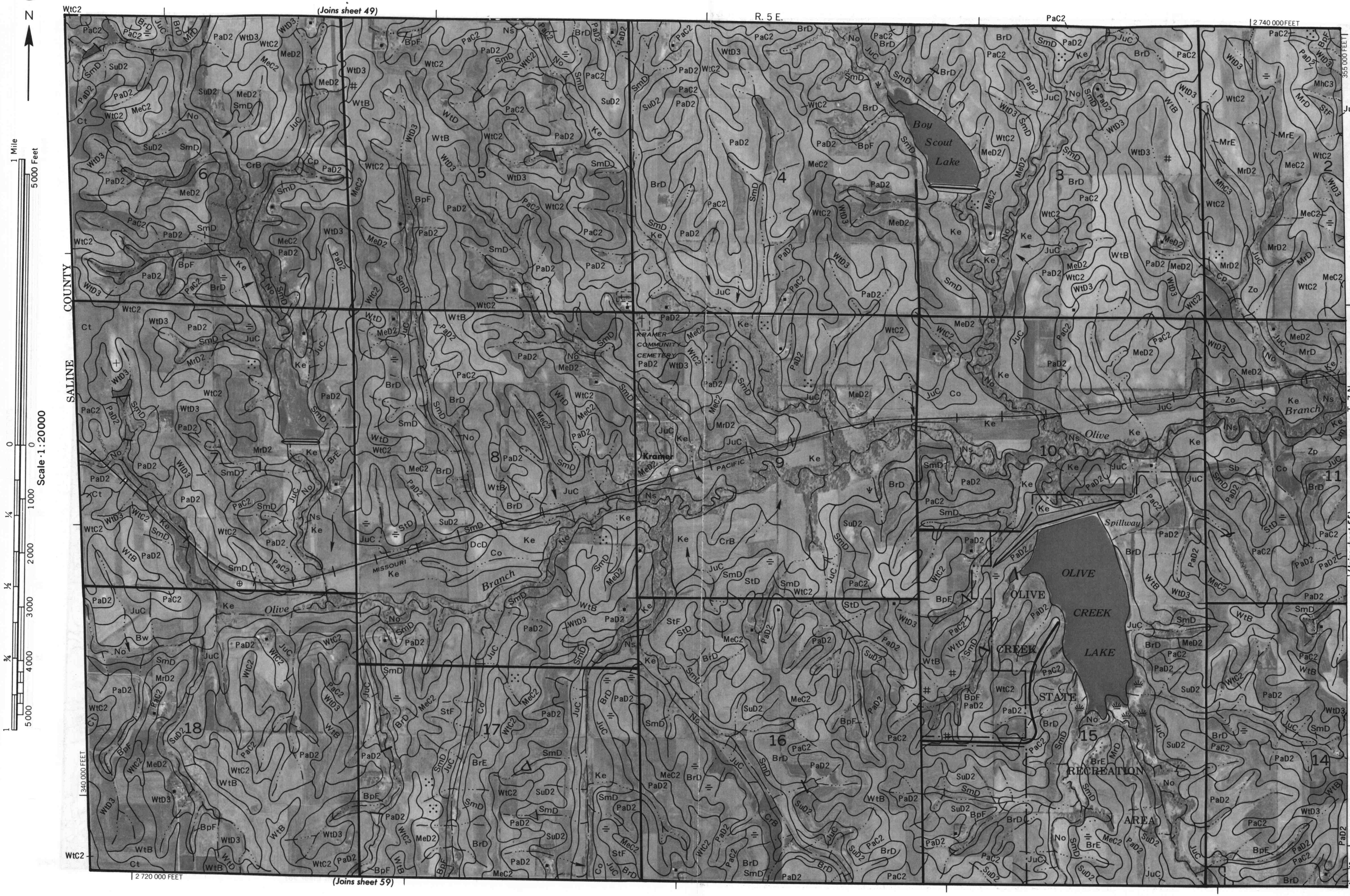


This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

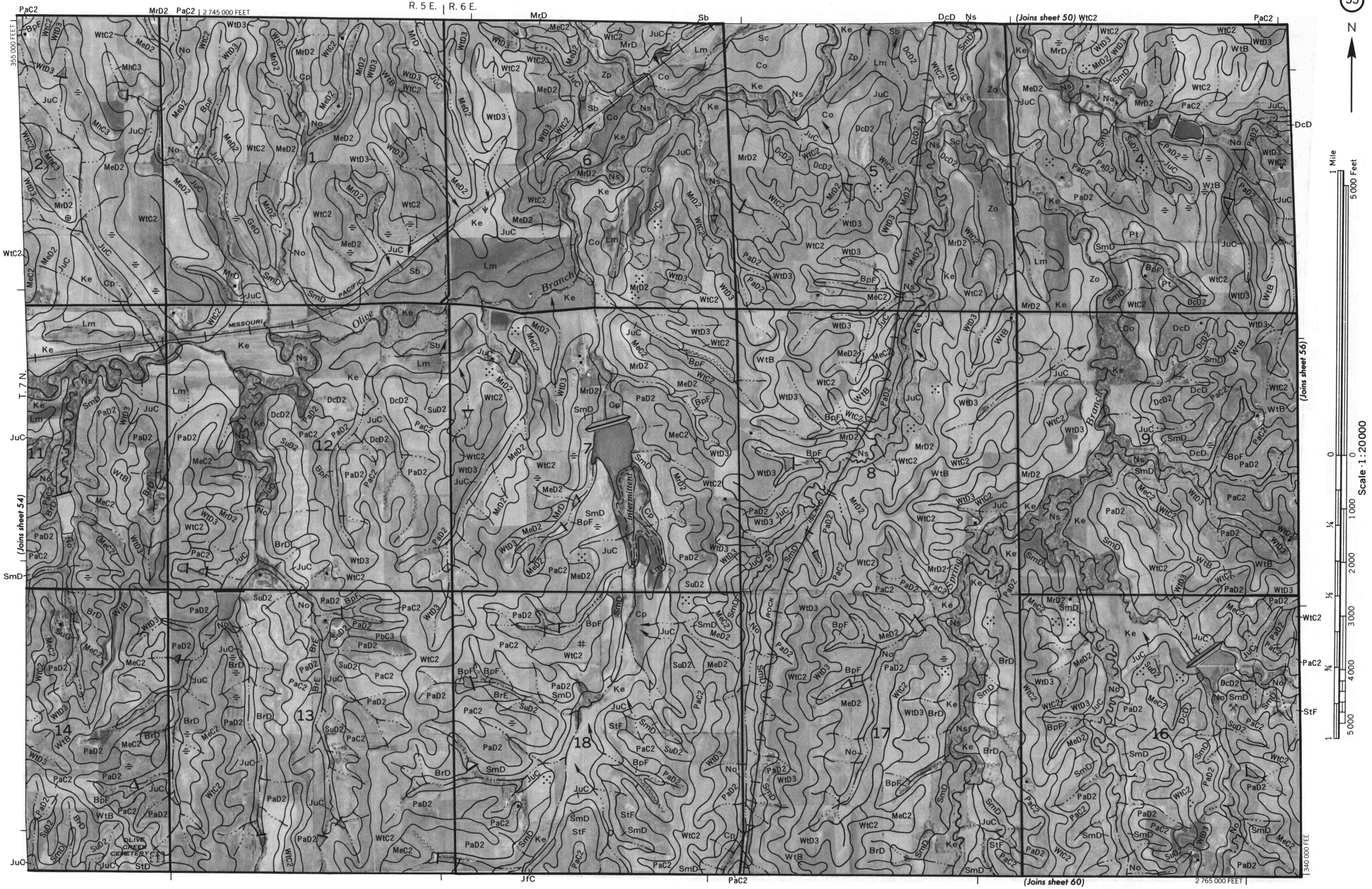


LANCASTER COUNTY, NEBRASKA NO. 53

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

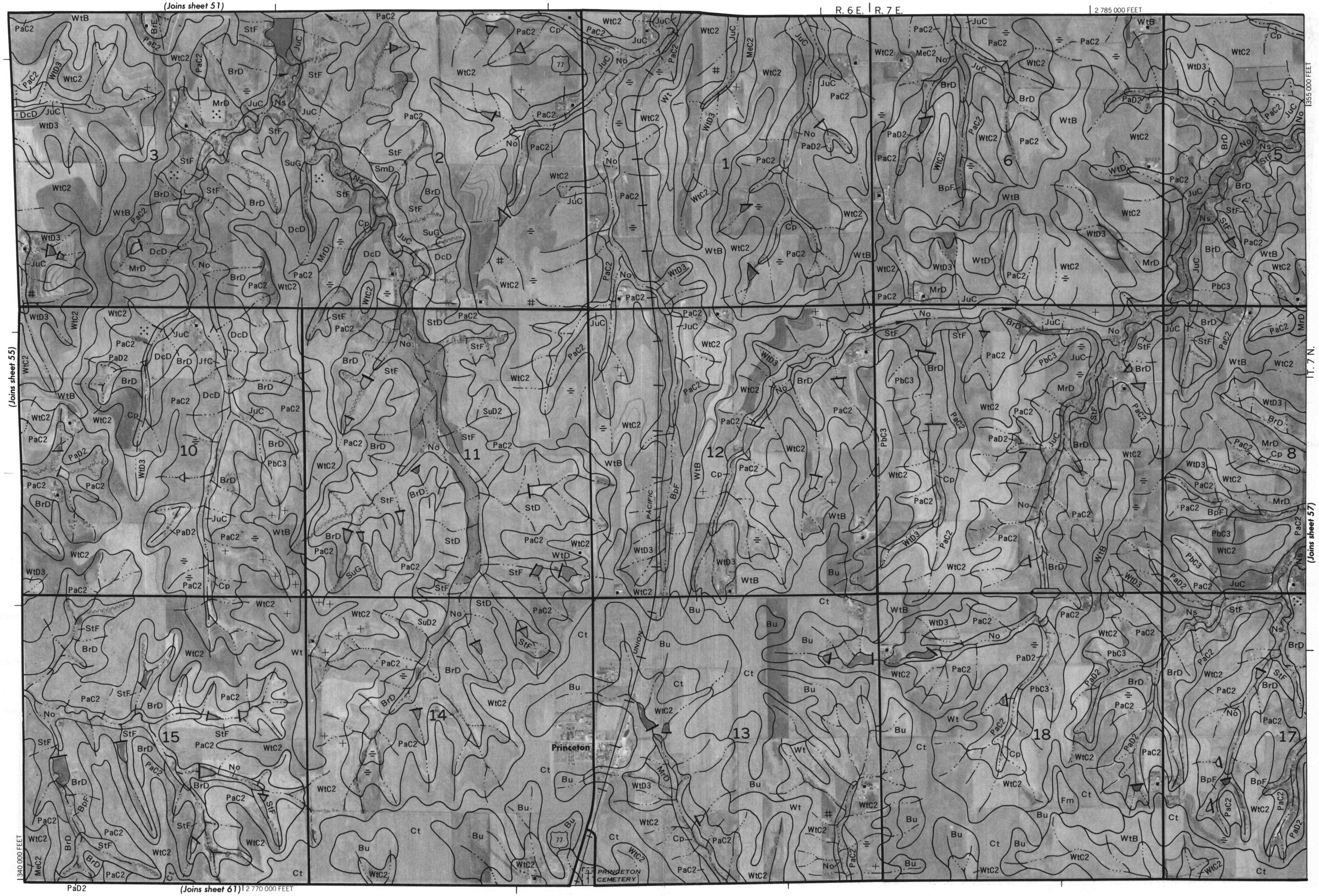


LANCASTER COUNTY, NEBRASKA NO. 55

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

56

N



1 Mile

5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

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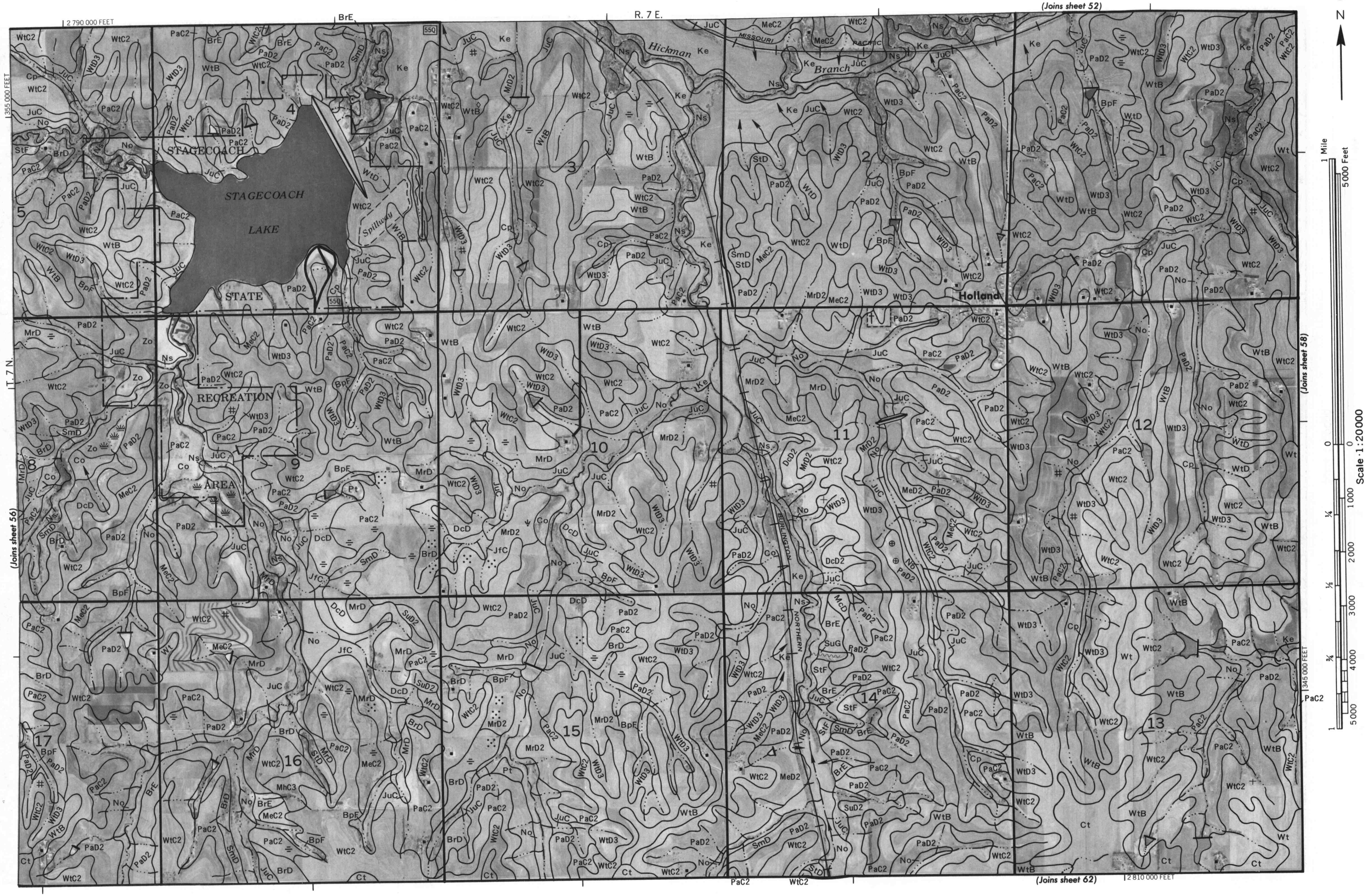
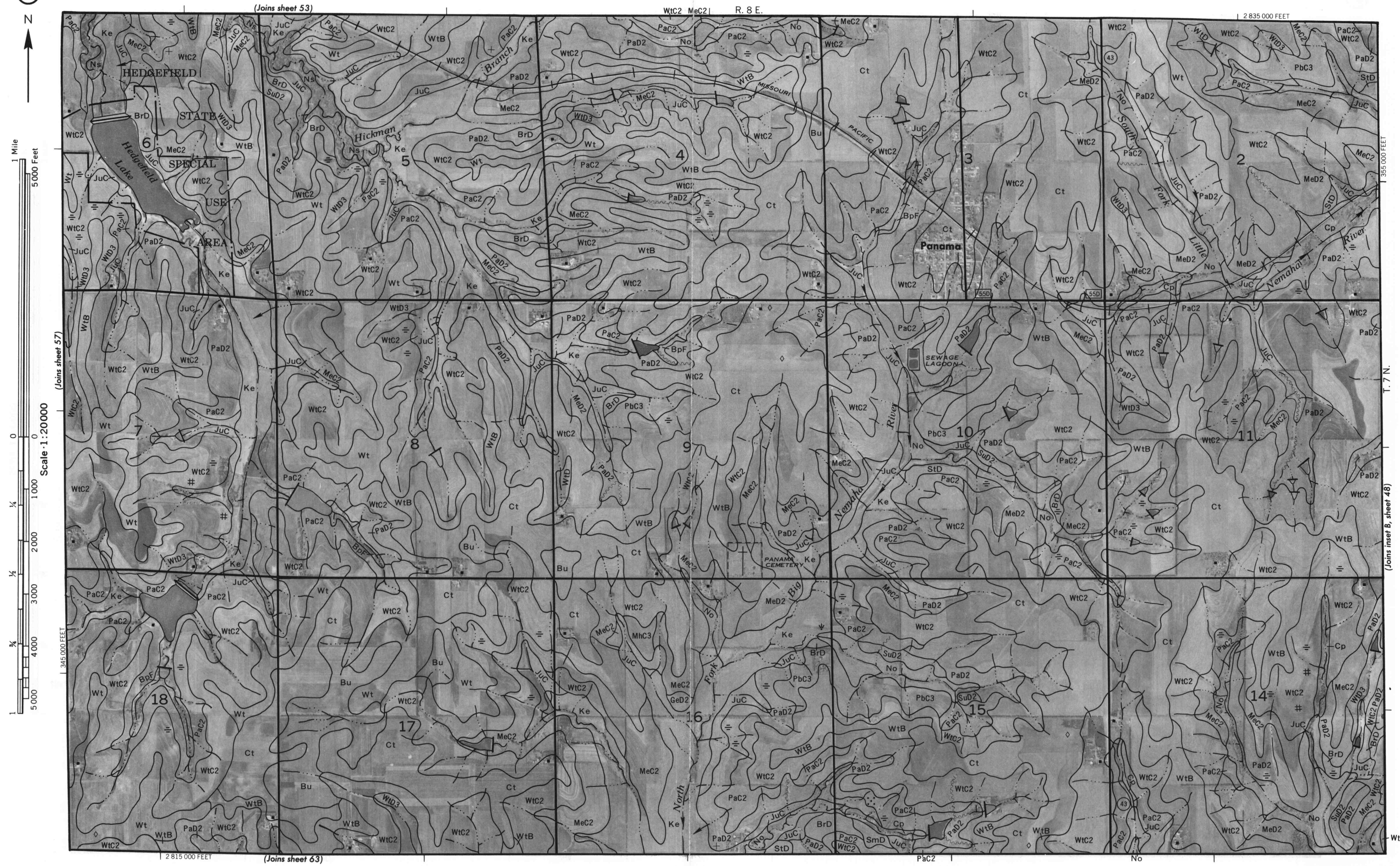
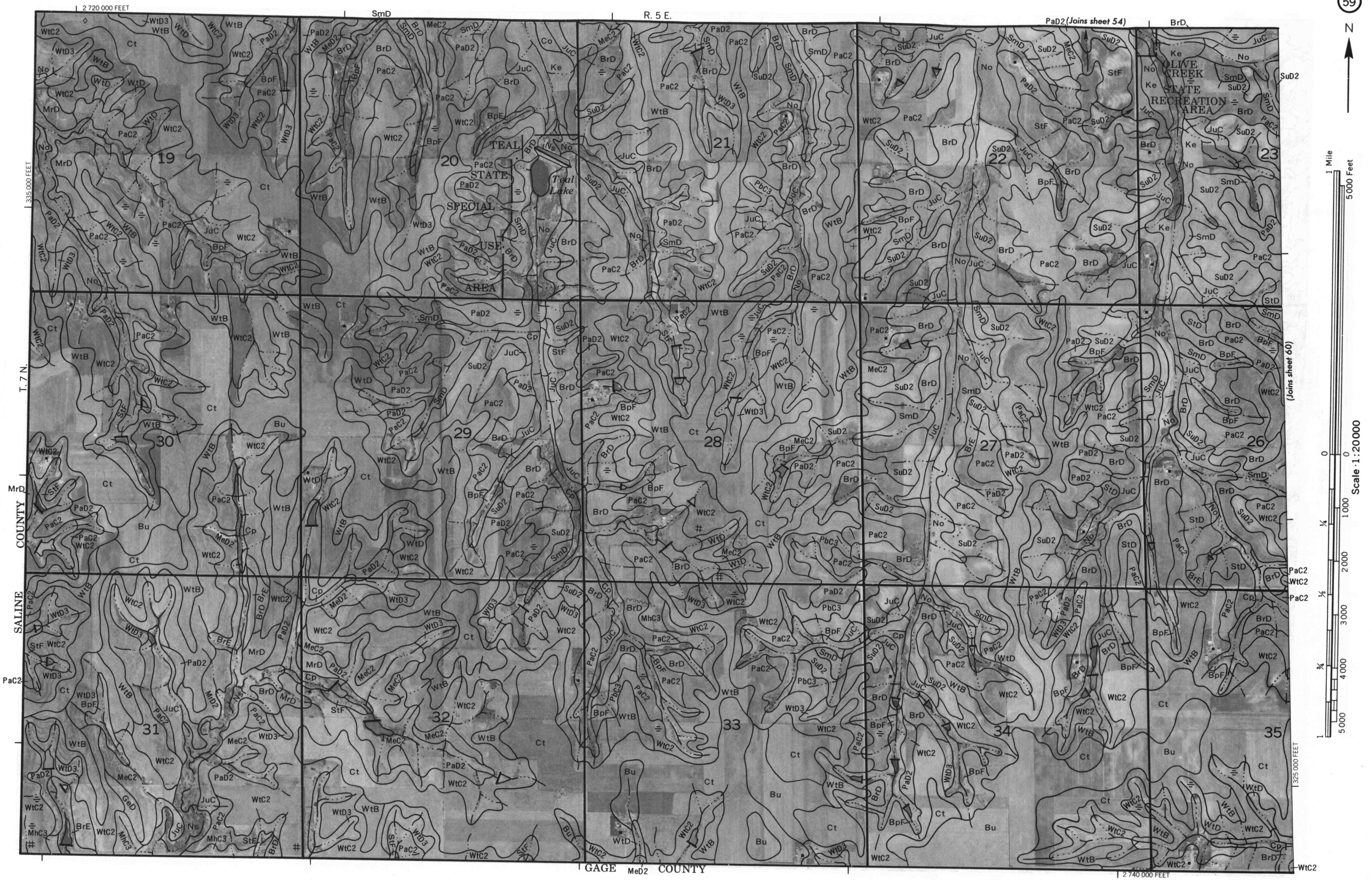
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 57
This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

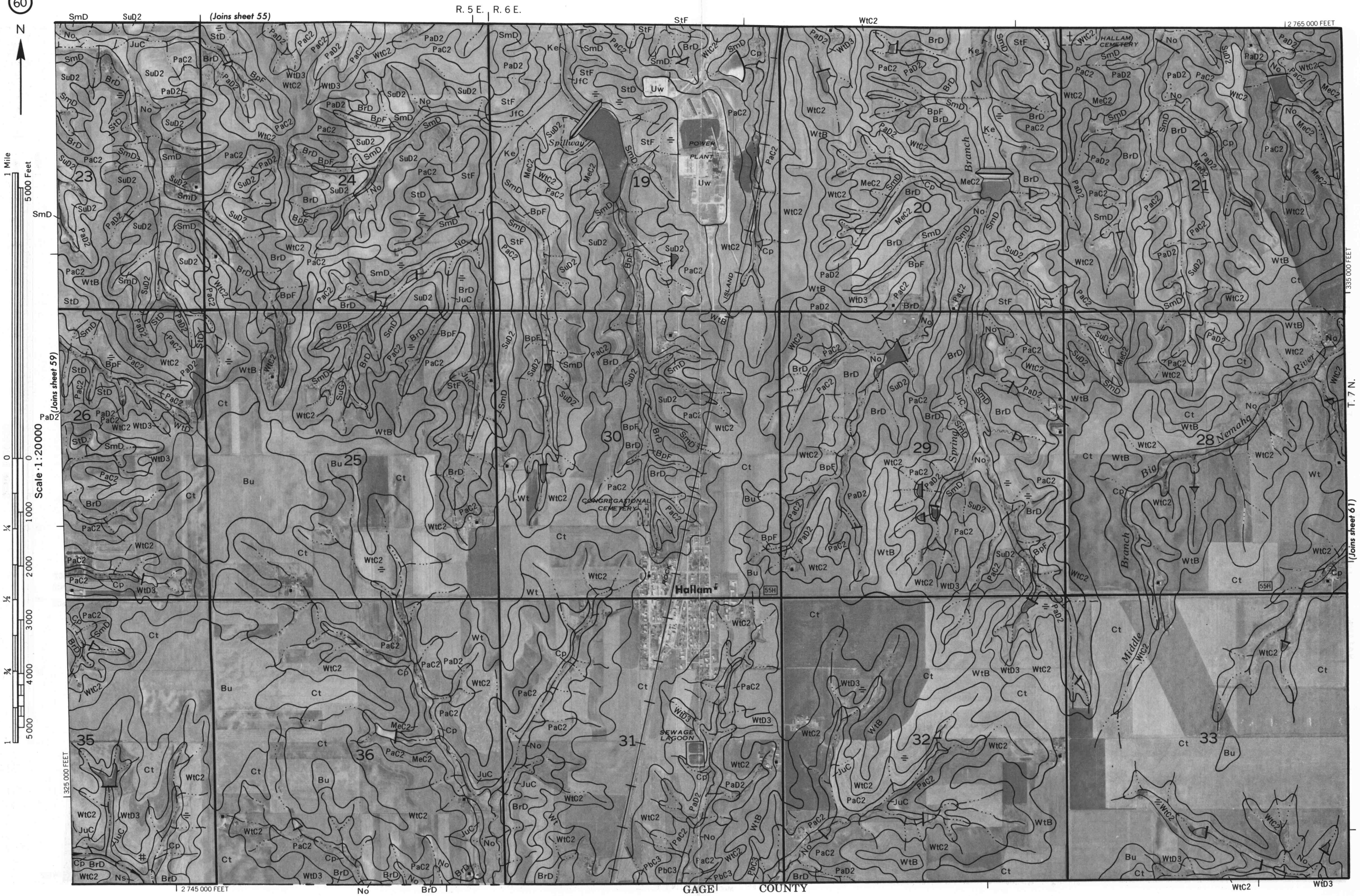


This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 59

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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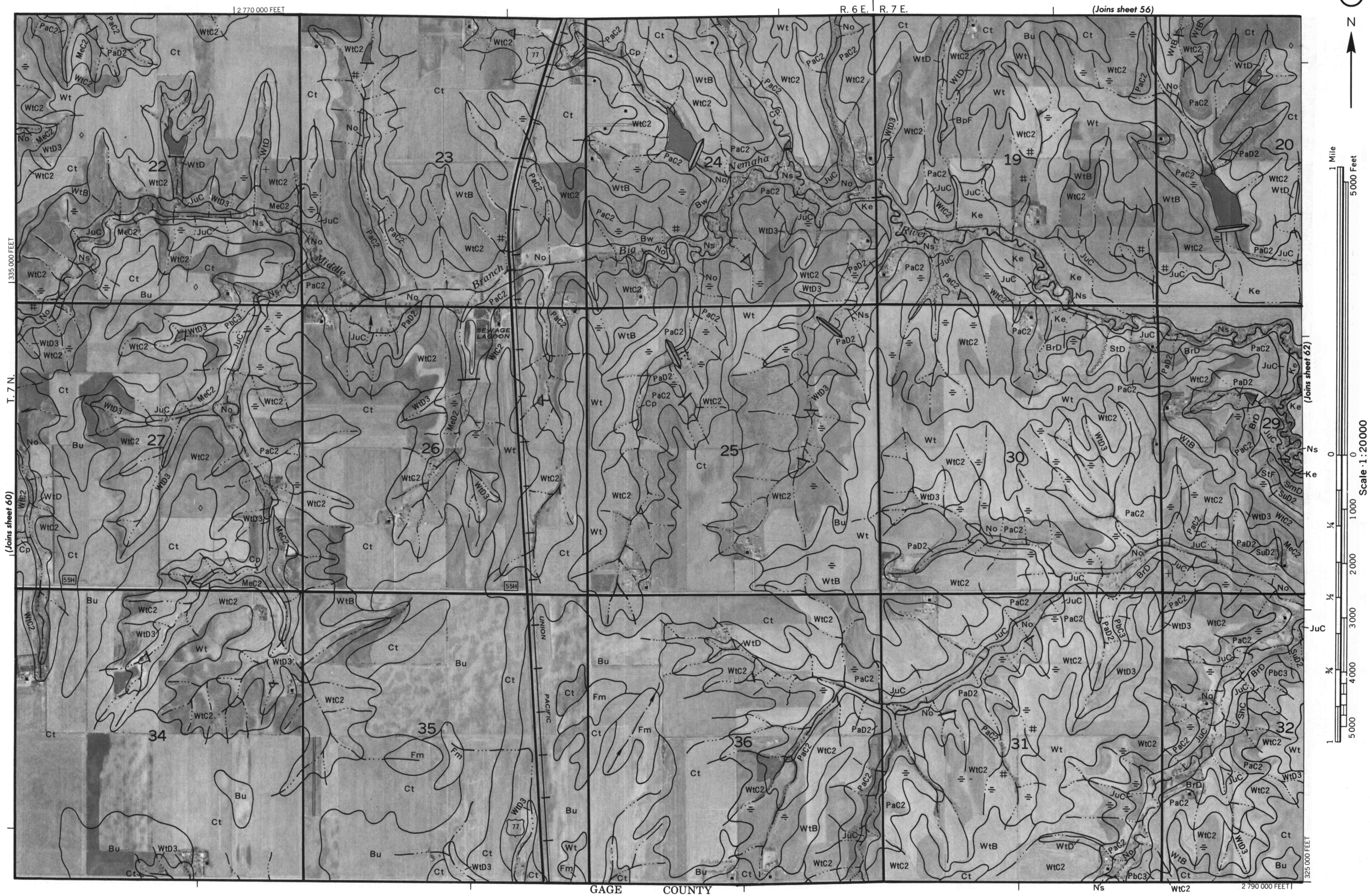
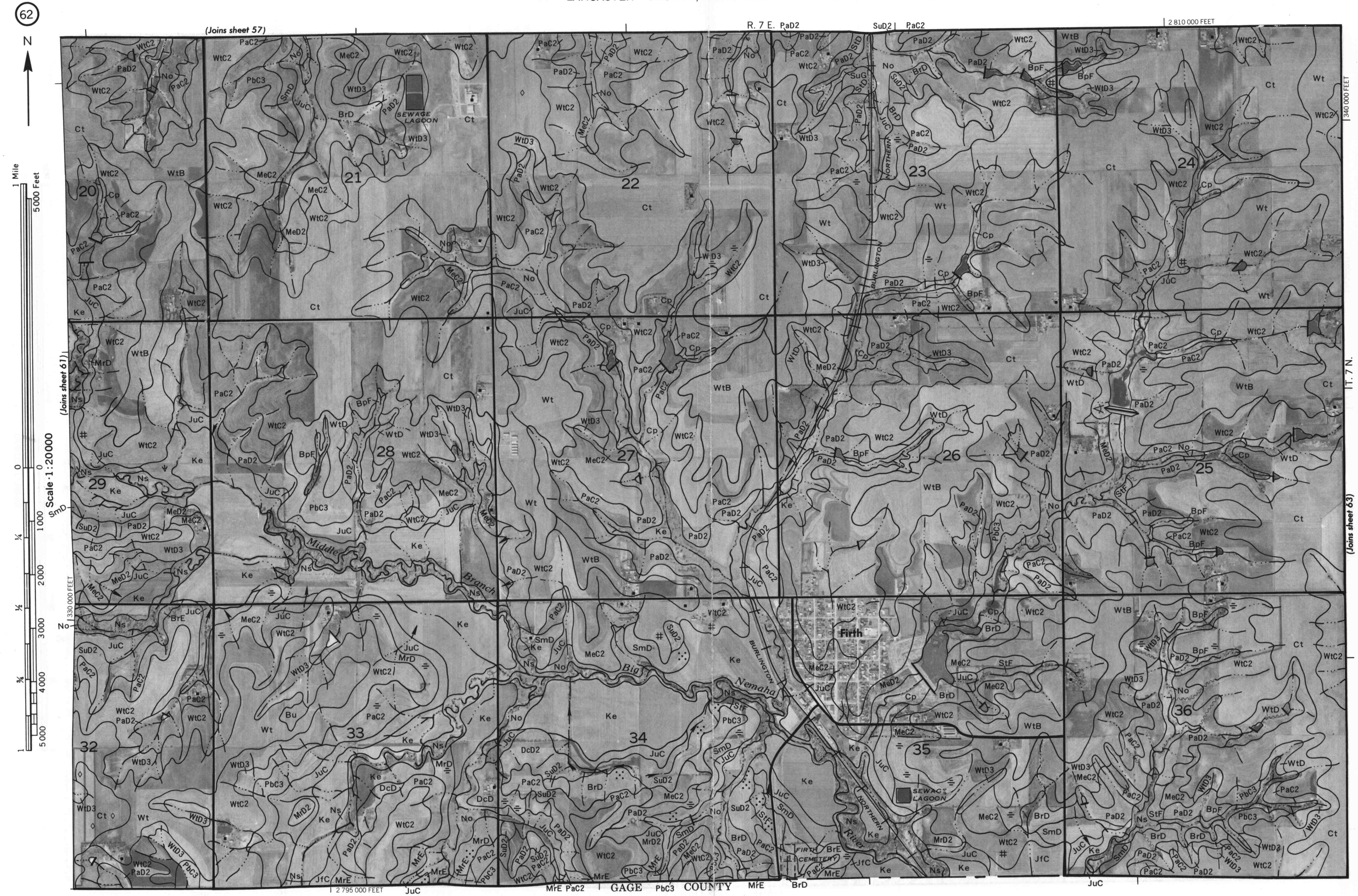
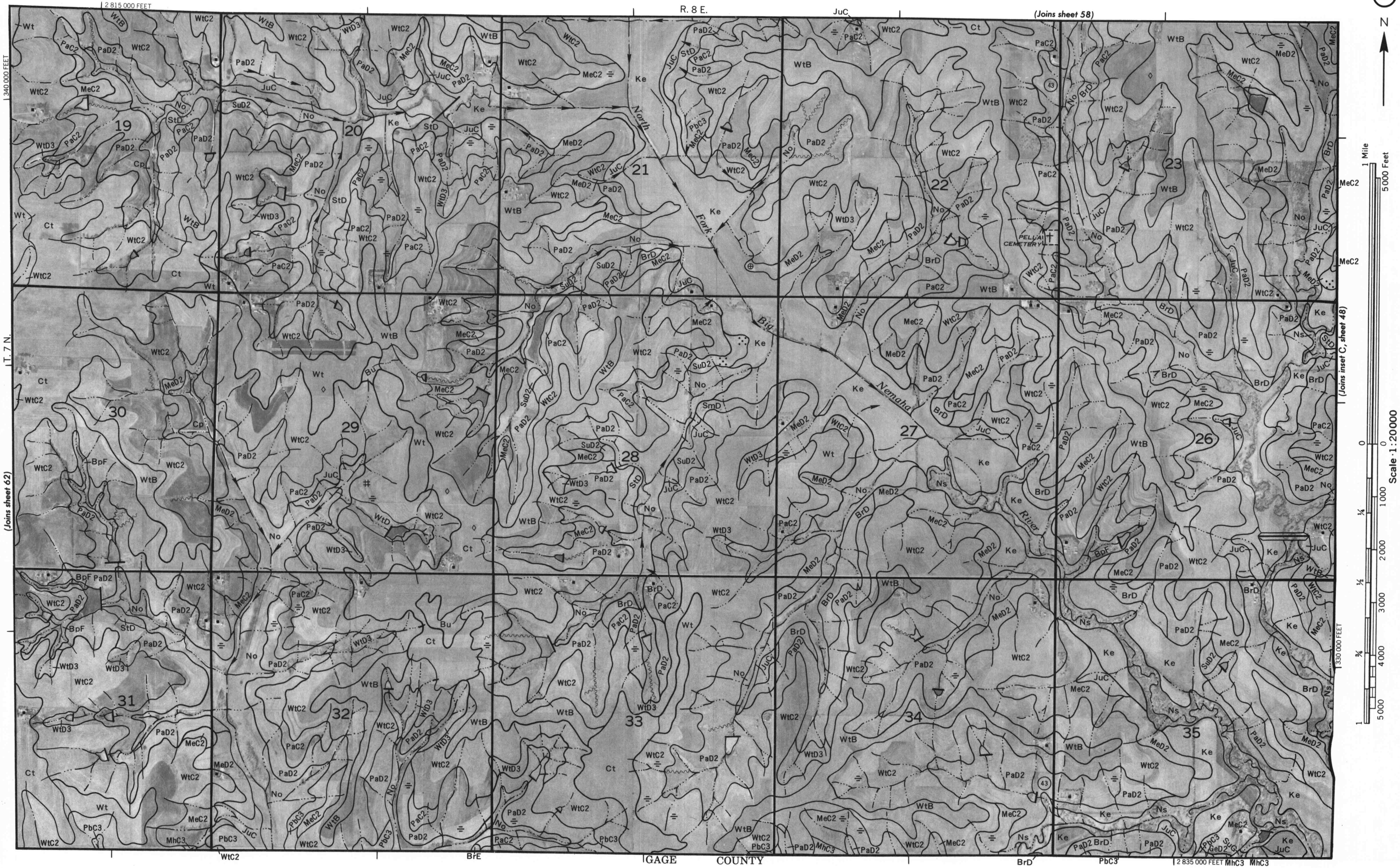




This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



LANCASTER COUNTY, NEBRASKA NO. 63

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.